AN EMPIRICAL ANALYSIS OF HEDGING WITH CURRENCY DERIVATIVES IN CHINA

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A thesis submitted for the degree of Doctor of Philosophy
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I would like to express my thanks to my supervisor, Dr Bruce Morley, who has guided and supported me throughout the PhD study. He has given me great help throughout my research and work, which I very much appreciate. I have learnt a lot from him, not only the academic knowledge but also about being a positive and helpful person. I also want to thank my second supervior, Paolo Zeppini, who has given me much support and useful advice throughout this long process.

I have dedicated this thesis to my parents, who are always on my side and have given me strong support for my dream. I have appreciated the PhD study, which broadens my horizon and makes me find what I want to do in the future.

ABSTRACT

As the international standing of China has improved, which has motivated more and more firms to take part in the global market for business. This study intends to investigate the sensitivity of firms involved in foreign business activities to fluctuating exchange rates, explore the determinants of foreign exchange exposure and firms' risk management strategies with currency derivatives, and examine the firm value effects arising from the use of foreign currency derivatives.

I initially examined the sensitivity of a firm's stock price to exchange rate changes and found that from July 2005 to 2012, around 8% of the listed firms on the Shanghai stock exchange have significant foreign exchange exposure and 6% of the listed firms experienced a lagged effect from exchange rate movements. The foreign involvement, which indicates the level of foreign trade of the firm, is a significant factor affecting the foreign exchange exposure in the post market liberalisation period. This is the first-time the liberalisation of the Chinese stock market after 2012 has been analysed when identifying the determinants of foreign exchange exposure. As few firms usually show any significant exposure, often known as the exposure puzzle, the study finds that an increasing number of multinational firms from the Shenzhen Stock market use foreign currency derivatives to hedge from 2012 to 2017. The level of trade is one of the significant determinants of hedging in China. Meanwhile, I consider agency problems and information asymmetry as determinants of derivatives use in the estimation. Furthermore, the main findings show that firms below the leverage threshold level of debt could benefit from the use of foreign currency derivtives. Meanwhile, the diversified ownership structure, indicating lower agency costs, is positively related to the firm value.

This study contributes to the literature on hedging with currency derivatives by exploring an emerging market instead of the more usual developed countries. It first finds that the level of foreign trade can reflect the foreign exchange exposure only after the financial maket is liberalised. Moreover, it employs dynamic panel model to examine the drivers of the use of foreign currency derivatives while the majority of studies previously focused on a static model. The study is the first to estimate the valuation effects of currency derivatives based on the threshold effect arising from the level of debt.

Overall, this study aims to analyze the use of currency derivatives in China and provide policy implications for various stakeholders. As derivatives are a double edged sword, the financial aurthorities and regulators should strengthen the capital markets levels of efficiency and transparency to ensure their stability while developing the financial derivatives markets.

Chapter 1

Overview Of The Thesis

1.1 Introduction

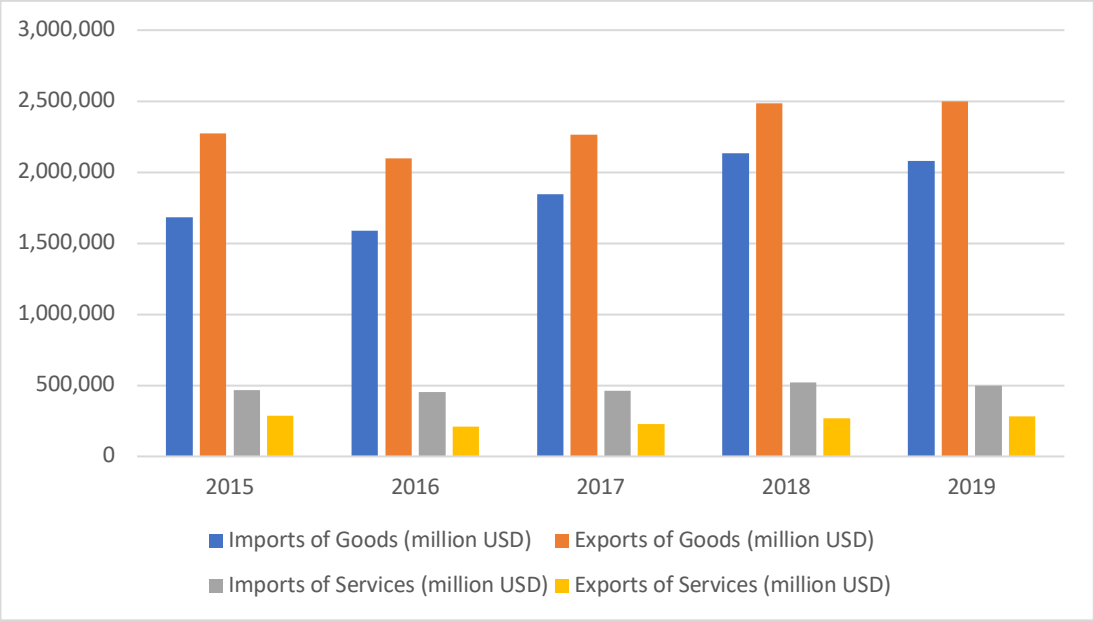
The Chinese exchange rate regime began being reformed in 2005 and the Renminbi entered into the currency basket of the IMF's special drawing rights in 2016, indicating the Chinese currency was developing internationally. In addition the Chinese currency became more flexible and as a result firms encountered more challenges from overseas business than ever before when trading internationally, so that it has become essential for firms to manage the risks caused by changes to the value of the domestic currency. During the financial crisis which started in 2007, currency derivatives have played an increasingly significant role in reducing the risks from trading with foreign countries. Allayannis, Lel and Miller (2012) and Marshall, Kemmitt and Pinto (2013) have demonstrated that the use of foreign currency derivatives is effective in hedging foreign exchange exposure. China has experienced a fast growth in its economy over recent years, but the derivatives markets have not been as well-devloped as developed countries. Due to this it is important to study the derivatives market in China, in terms of its efficiency and security, so it can strengthen its international position around the world. Du et al. (2018) have completed some initial studies on the estimating of the currency exposure relative to Renminbi.

The derivatives and foreign exchange markets in China have grown quickly over recent years, which has enabled firms and banks to opt for forward instruments to lock in foreign exchange risks. In 2017, the amount of foreign exchange derivative transactions in China increased to 14,595 billion US dollars, which is disclosed by the State Administration of Foreign Exchange of China. Compared with 2016, the derivative transactions have expanded by 27%. With a rapid expansion of markets for Chinese exporters and importers, an increasing number of firms would like to hedge using foreign currency derivatives, as supported by Luo and Wang (2018). However, derivatives have been considered as speculation, as their markets are not as well developed in China as in developed countries, such as the US. Unlike US firms, Chinese firms are more state-controlled and Hutson, Laing and Ye (2019) have previously explored whether the ownership structure affected the decision to reduce foreign exchange risks. It is important to examine the effectiveness of foreign currency derivatives and what drives their use by

Chinese firms, which motivates this study into the current situation concerning the state of foreign exchange hedging in China.

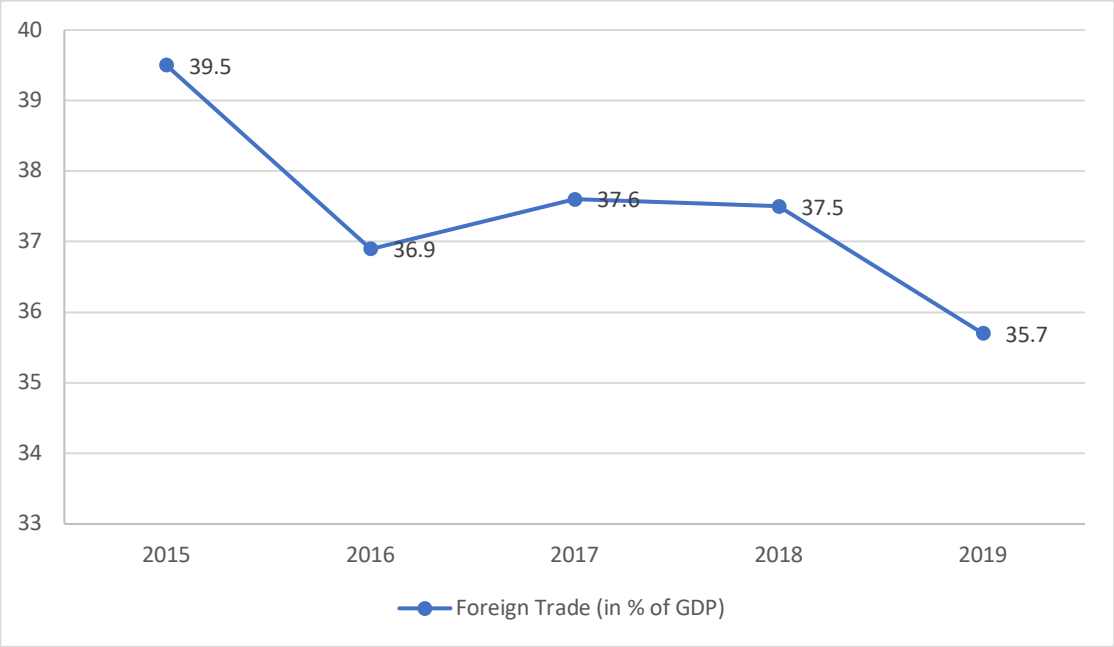
The majority of studies in the area of hedging tend to concentrate on developed countries, such as in the US, UK and Germany as explored by Griffin and Stulz (2001), Fauver and Naranjo (2010) and Huston and Laing (2014). There are very few studies focusing on China, as the development of the foreign exchange market is relatively new. A limited number of studies related to hedging employ cross-sectional analysis or standard panel analysis, ignoring the main problems of endogeneity and the dynamic nature of the relationships. The thesis intends to explore the effects of exchange rate movements and how firms deal with foreign exchange risks. At the same time, this study aims to determine the motivations for hedging in China and the effect of currency derivatives on firm value, which could provide information for regulators to further develop the foreign exchange markets in a secure and efficient way.

Figure 1.1 The level of trade in China



(source: World Trade Organisation (WTO) ; Standertrade website, Avaliable from https://santandertrade.com/en/portal/analyse-markets/china/foreign-trade-in-figures)

Figure 1.2 The level of foreign trade in China

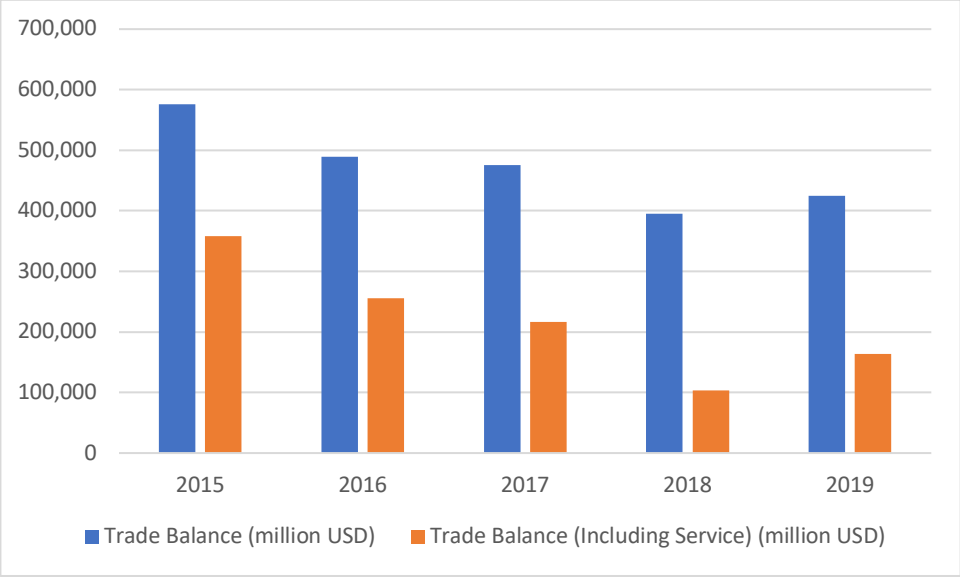


(source: World Trade Organisation (WTO) ; Standertrade website, Available from https://santandertrade.com/en/portal/analyse-markets/china/foreign-trade-in-figures)

1.2 Motivations and research questions

The foreign exchange markets in China have developed rapidly since the exchange rate regime became flexible. With variable exchange rates, capital flows between countries have been promoted leading to firms facing enormous challenges from exchange rate volatility. Compared with the developed countries, flexible exchange rates had not been applied to China for many years until 2005. Luo and Jiang (2007) and Liu and Yang (2010) identified the effects of volatile exchange rates on firms' performance since the managed-floating exchange rate regime has been adopted. Chinese firms with foreign trade are now increasingly affected by exchange rate shocks and they need to adapt their operations and management to account for the fluctuations of the exchange rate. In China foreign trade is an essential component of GDP and in particular exports play an important role in their foreign trade. From 2016 to 2019, the exports of goods have increased by around 20% and have reached 2,499,457 million dollars, which can be seen in Figure 1.1. It also shows that there is a trade suplus for China as the overall level of exports is higher than the level of imports over recent times. As imports of services are greater than the exports of services, the trade surplus decreases when the trade balance includes services and goods, which can be observed from Figure 1.3.

Figure 1.3 Trade balance in China



(source: World Trade Organisation (WTO) ; Standertrade website, Available from https://santandertrade.com/en/portal/analyse-markets/china/foreign-trade-in-figures)

As the exchange rate regime is now a form of managed float, which is different from the purely flexible system used in other countries, it is worthwhile focusing on examining the effects of

exchange rate movements on the firm and how they react to foreign exchange shocks. This is Particularly the case for exporting firms, who have an important role in drivingt GDP, so it is esstential to undersand the current situation regarding exchange rates, as they have become more volatile and the exchange market become relatively more flexible. Exports would be significantly influenced by the appreciation of Renminbi, as they become more expensive in the foreign market. As can be seen in Figure 1.2, the level of foreign trade has decreased from 39.5% of GDP to 35.7% from 2015 to 2019 as the exchange rates have become more volatile.

As increasingly volatile exchange rates affect the Chinese firms exchange rate risks and their risk management strategies, few studies so far have focused on the area of foreign exchange exposure and hedging in China while Jorion (1990), Allayannis and Ofek (2001), Bartram, Brown and Minton (2010), Giambona, Graham, Harvey and Bodnar (2018) focused on examining the theory and empirical studies in developed countries, this study intends to answer the following questions by exploring the financial markets in China.

Research questions: Jorion (1990) first put forward a two-factor model to examine the effects of foreign exchange rate movements on stock price returns, this has been considered as a traditional approach in this research area and applied to many previous studies, such as Fauver and Naranjo (2010), Hutson and Laing (2014) and Zou and Luo (2017). Since the exchange rate regime has been reformed from 2005, firms in China are now exposed to a more volatile exchange rate environment. This study firstly intends to answer the following question,

1) What is the relationship between stock prices and exchange rates in China? How does the level of foreign trade influence the sensitivity of stock prices to exchange rate changes?

There is an increasing number of firms which use the foreign currency derivatives to reduce foreign exchange exposure in China, as found by Luo and Wang (2018). Hu and Wang(2005) provide evidence on drivers of the foreign currency hedging employed by firms in Hongkong where firms face currency risks due to foreign business opportunites. Since the foreign exchange market and the derivatives maket have developed rapidly in the mainland of China over recent years, it is now vital to explore the factors affecting the use of foreign currency derivatives to help firms manage their risks and regulators to stablise the financial markets. Thus, I put forward the second research question of my study.

2) What are main determinants of foreign currency derivative usage for hedging?

Smith and Stulz (1985) proposed a hedging policy theory which indicated that the use of foreign currency derivatives benefied firms in terms of the value premium due to imperfect markets. Previous studies provided ambiguous evidence on the firm valuation effects of using hedging strategies, which is supported by Aretz and Bartram (2010). The prevalent listerature, such as Hutson, Laing and Ye (2019) and Huang, Huang, and Zhang (2019), further explored who would benefit from hedging foreign exchange risks. This study examines the effect of the use foreign currency derivatives on the firm's value and as Black (1976) has illustrated, the risks of firms are determined by their level of debt, so I intend to explore the firm valuation effects of hedging with respect to the capital structure of the firm in the last empirical chapter. In conclusion, I propose two questions, which are shown below,

3) How is shareholders' value affected by hedging with currency derivatives over time?

4) What is the effect of hedging with currency derivatives on firm value conditional on a threshold of capital structure?

1.3 Main contributions

As far as I know, there are very few studies focusing on the Chinese market and implementing empirical analysis on the topic of hedging exchange rate risks. The thesis contributes to the literature by enriching the empirical analysis of multinational firms in China and how they reacted to the move to flexible exchange rates through the following aspects.

A majority of the studies relating to foreign exchange exposure have focused on developed countries with the floating exchange rate regimes, such as Jorion (1990), Allayannis and Ofek (2001), Fauver and Naranjo (2010) and Giambona, Graham, Harvey and Bodnar (2018). The study first examines the foreign exchange exposure of firms' in China with a managed-floating exchange rate regime and determines whether the exposure is dependent on the level of foreign trade while controlling for the firms characteristics. Similar to other emerging markets, such as Hongkong, Malaysia, and Korea, and developed markets, such as US, this study found similar results as the firm experiences a negative effect from the appreciation of the domestic currency.

Thus, this study extends the evidence to emerging markets by exploring the financial markets in China.

The thesis explores the drivers of hedging with currency derivatives by including agency problems and asymmetric information in China for the first time. I have also collected by hand the derivatives data from the annual reports of the firms in my sample, to form my own dataset. Furthermore, it identifies the potential effect of previous decisions on the current hedging behaviour, which has rarely been considered in other studies. Allayannis and Ofek (2001) and Fauver and Naranjo (2010) have only focused on exploring the determinants of hedging in the static model.

Considering the mixed valuation results from the previous literature, introducing a threshold dynamic analysis as proposed by Seo and Shin (2016), this study intends to examine how hedging affects the firm value with repect to the firm's capital structure and whether it is affected through agency costs and asymmetric information. This study first identifies the hedging effect on the value of the firm conditional on the level of debt to equity.

Concentrating on the methodologies used in this study, this empirical study employs dynamic panel models, including a dynamic probit model, GMM, and threshold GMM, for the first time in a study on foreign exchange hedging and to analyse corporate hedging behaviour whilst considering the endogeneity and identification problems.

1.4 Structure of thesis

The structure of the remaining contents of the thesis are as follows,

Chapter 2 provides an introduction into the developments of the exchange rate regimes in China over recent years and provides an overview of the Chinese financial markets, including the capital markets, foreign exchange market and derivatives market. Meanwhile it introduces the circumstances behind firms facing volatile currencies and requiring risk management strategies at the moment.

Chapter 3 summarizes the concepts behind foreign exchange risks and presents the underlying hedging theories explaining how hedging with derivatives increases firm value in the real world.

Chapter 4 determines the sensitivity of firms to shocks in the exchange rates and the factors influencing the foreign exchange risks. This chapter concentrates on examining the foreign exchange exposure of firms and explores the relationship between the level of foreign trade and the risk exposure.

Chapter 5 employs dynamic panel models to examine the determinants of hedging with foreign currency derivatives in China. It mainly focuses on whether the level of foreign trade, agency costs and asymmetric information could drive firms to hedge and whether the relationship is non-linear.

Chapter 6 implements a threshold dynamic analysis of the hedging effect on the firm's value. This chapter studies the dynamic firm value effect of hedging with the generalised method of moments and further explores firm value effects based on a leverage threshold effect.

Chapter 7 concludes the results of the empirical analysis from the previous chapters and provides the policy implications of the thesis. Meanwhile, the limitations of the thesis are discussed and the further research in this field suggested.

Chapter 2

Background To The Study

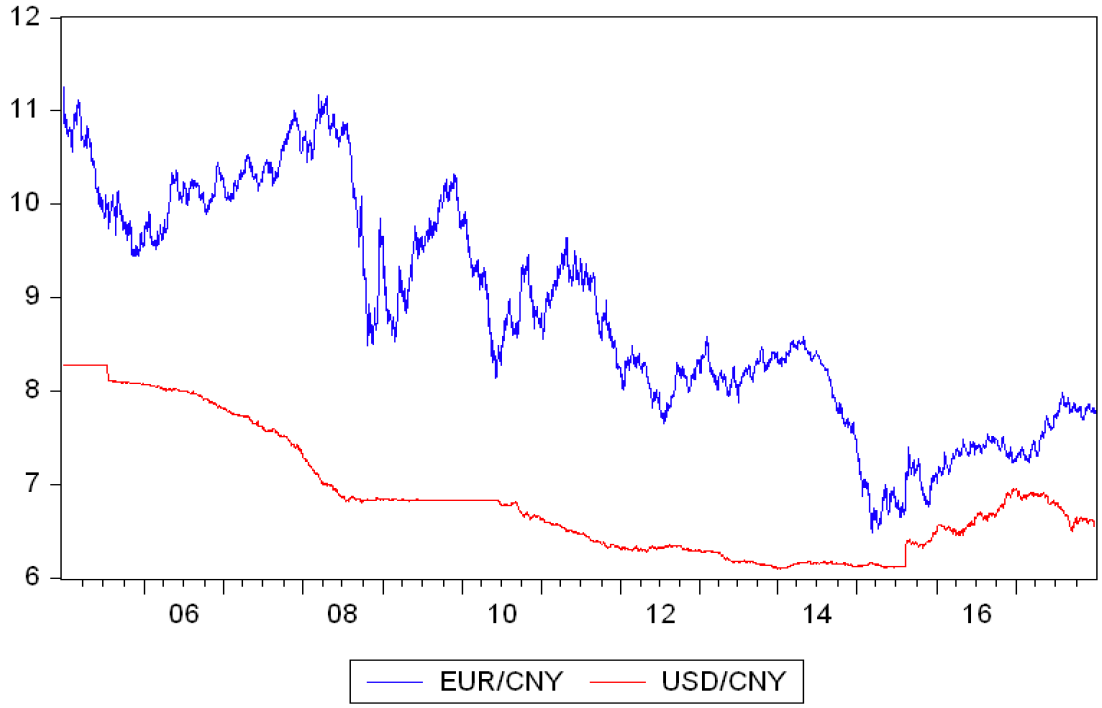
2.1 Background to the markets

2.1.1 The exchange rate regime in China

Since the collapse of the Bretton Woods System in 1973, when the international fixed exchange rate regime system came to an end, countries have needed to adapt to floating exchange rate regimes. The fluctuation of the exchange rate not only brings risks to exporters and importers but also causes uncertainty to the macro economy as a whole. Over recent decades, the study of floating exchange rates has attracted much interest and it has become an important part of international finance, such as Adler and Dumas (1984), Jorion (1990), Allayannis, Lel and Miller (2003), Huston and O'Driscoll (2010), and Gu, Yang and An (2014).

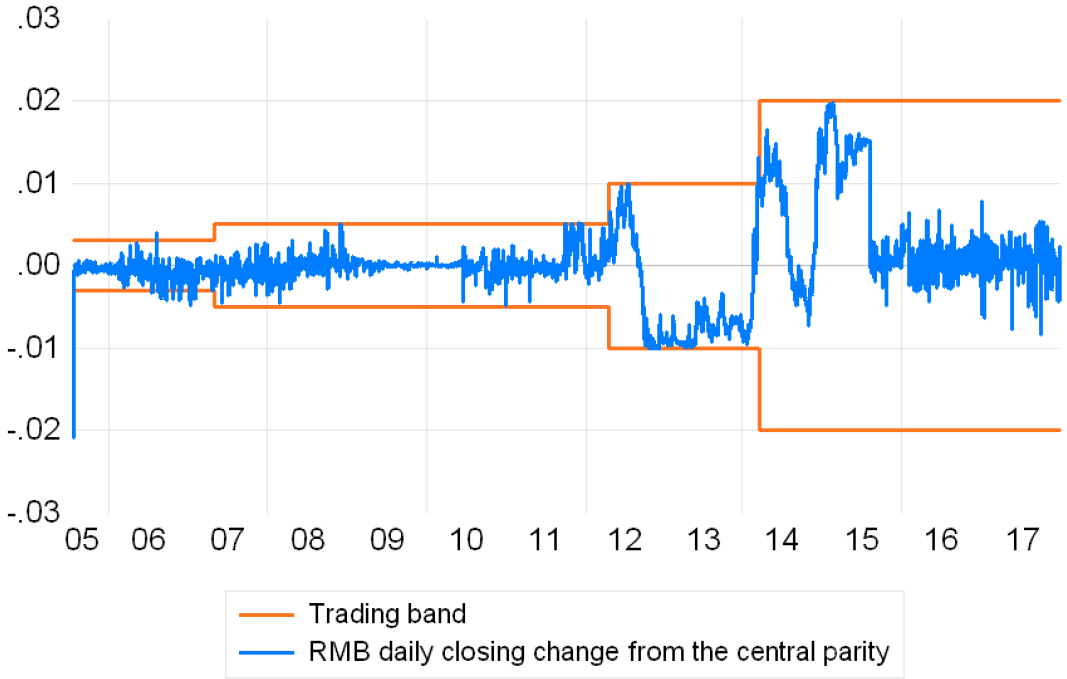
In the short run, under a market-oriented economy, exchange rate changes could have affected firms' value through many ways, such as the costs of raw materials, sales revenue, wages, market demand and supply. In the long term, the fluctuation of the exchange rate could influence the competitive ability of the industry, which could affect the long-term profitability of a firm. In China, the exchange rate has been pegged to the dollar during the past decades and the dollar was used for international settlement and for investment abroad, which means the exchange rate risk was limited to the country level. Firms, as micro individuals, were not sensitive to the exchange rate changes. However, China finally and formally started to take part in the WTO in Dec 2001, which meant that firms in China would face more international competition and exchange rate risk. The appreciation of the RMB (Chinese currency) made the government relax financial controls and made the foreign exchange market freer and more international. Table 2.1 shows the evolution of the exchange rate regime using the historical timeline.

Figure 2.1 Exchange rates over time (Renminbi per US dollar & Renminbi per Euro)



(source: International Monetary Fund; International Financial Statistics; Available from https://www.imf.org/en/Data)

Figure 2.2 Renminbi daily closing change relative to the central parity



(source: International Monetary Fund, International Financial Statistics; Available from https://www.imf.org/en/Data; State Administration of Foreign Exchange; Available from https://www.safe.gov.cn/en/DataandStatistics/index.html)

The renminbi experienced a gradual depreciation over the previous 16 years up until the reform of the exchange rate regime in 1994. Although a managed floating exchange rate regime was implemented, the renminbi has been pegged to the US dollar since the Asian financial crisis in July 1997. Figure 2.1 shows that the exchange rate was fixed at 8.28 Renminbi per US dollar until 2005. From July 2005, the government carried out further exchange rate reforms, which meant that the pegged exchange rate regime changed to the managed floating exchange rate regime, adjusting to the demand and supply of currency in the market relative to a basket of currencies. Accompanying the reforms, the USD/RMB rate was revalued to 8.11 yuan per dollar and the floating range of the exchange rate was extended to 0.3%(+/-). The central bank announced that the renminbi was to appreciate by 2%, which was a way of fine-tuning the exchange rate. It can be observed that compared with the EUR/CNY rates, the USD/CNY rates have been relatively stable. As the foreign exchange markets were not as well-developed as in more developed countries, a managed floating exchange rate is considered as an effective way to reduce the risk of exchange rate volatility to firms and households in China. Gu, Yang and An (2014) examined the level of exposure to volatile exchange rates by Chineses listed firms since the start of the reformation of the exchange rate regime. In 2006, the formation of the central parity price was improved so as to support the development of the foreign exchange markets in a further step by introducing over-the-counter trading and a market-maker system, which has reduced the difference with other countries regimes and promoted increased stability in the foreign exchange markets.

Although the exchange rate was heavy controlled, the renminbi was more volatile than before and the renminbi appreciated by 15% between 2005 to 2008. The global financial crisis caused by the U.S. in 2008 hindered the progress of the reforms of the exchange rate because the government limited the volatility of the Renminbi to stabilize the financial markets by mitigating against exchange rate shocks. It can be seen from Figure 2.1 that the USD/RMB remained relatively stable from 2008 to 2010. As the economy became more stable afterwards, the government tended to increase the sensitivity of the Renminbi to other currencies to further develop the exchange rate regime in 2010, this related to the restarting of reforms to the exchange rate.

Table 2.1 The Evolution of the Exchange Rate Regime

Year	Events
1994	Renminbi is pegged to the dollar and the China Foreign Exchange Trade System was set up.
2005	The Reformation of exchange rate regime(Managed floating exchange rate)
2001	China took part in the WTO.
2006	The formation of the central parity price has been improved and Over-the-Counter market and market-maker system are introduced into China.
2010	After recovery from financial crisis, the reform of the exchange rate restarted.
2014	The central bank increased the trading band to 2%.
2016	The Renminbi was added to the Special Drawing Rights' basket of currencies.

source: State Administration of Foreign Exchange (SAFE)

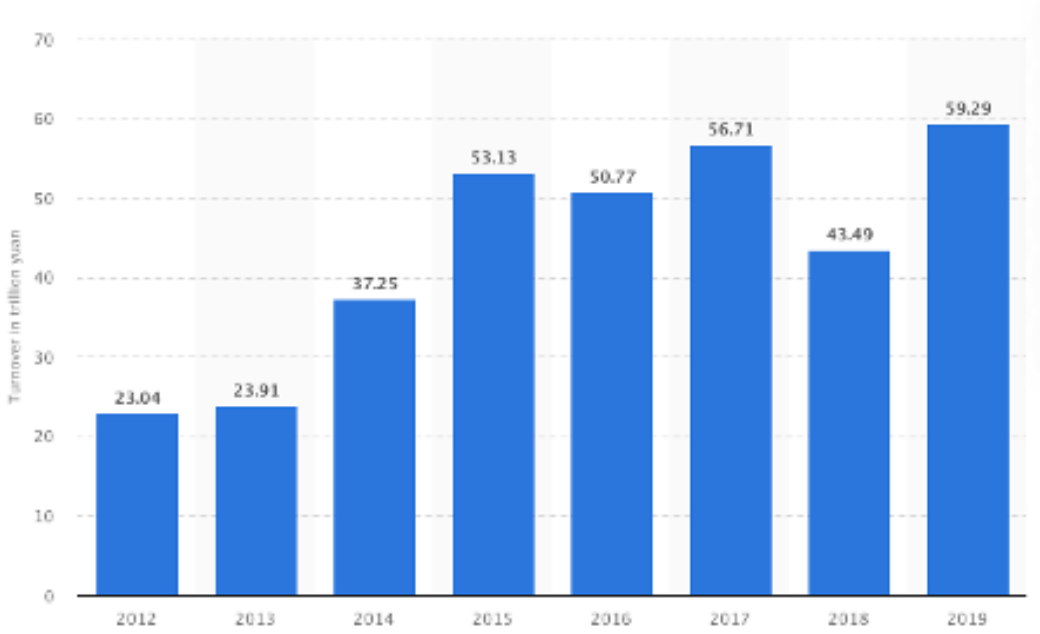
Then, in 2014, the central bank increased the range that was permissible for floating to 2% in a day, which meant the exchange rate became more flexible and more important to the performance of firms and governments. As Figure 2.2 shows, the floating band of the exchange rates has been gradually widened through a process of the exchange rate regime reformation, so that the exchange rates can better reflect market demand and supply than before. With the flexibility in the foreign exchange market, from 2014 to 2016, the value of the Renminbi went back to its level before financial crisis. In 2016, the Renminbi was added to the Special Drawing Rights' basket of currencies, which means that the Renminbi has become an international currency and faces pressures from the global market. Moreover, firms have become more sensitive to the changes in the exchange rates as they have encountered a competitive market with foreign competition. The value of the Renminbi increased after 2016, which has had a negative effect on exporting firms in China. On the other hand, the appreciation of the Renminbi should attract more foreign investors to China promoting increased flows between capital markets. Thus, the appreciation of the domestic currency is a double edged sword and it could bring benefits if the financial markets are well-developed. The next section will discuss the development of the financial markets in China.

2.1.2 The capital markets

The Chinese stock markets have expanded quickly in recent years and become the second largest behind the US market as the total market capitalization has reached Renminbi 59.29

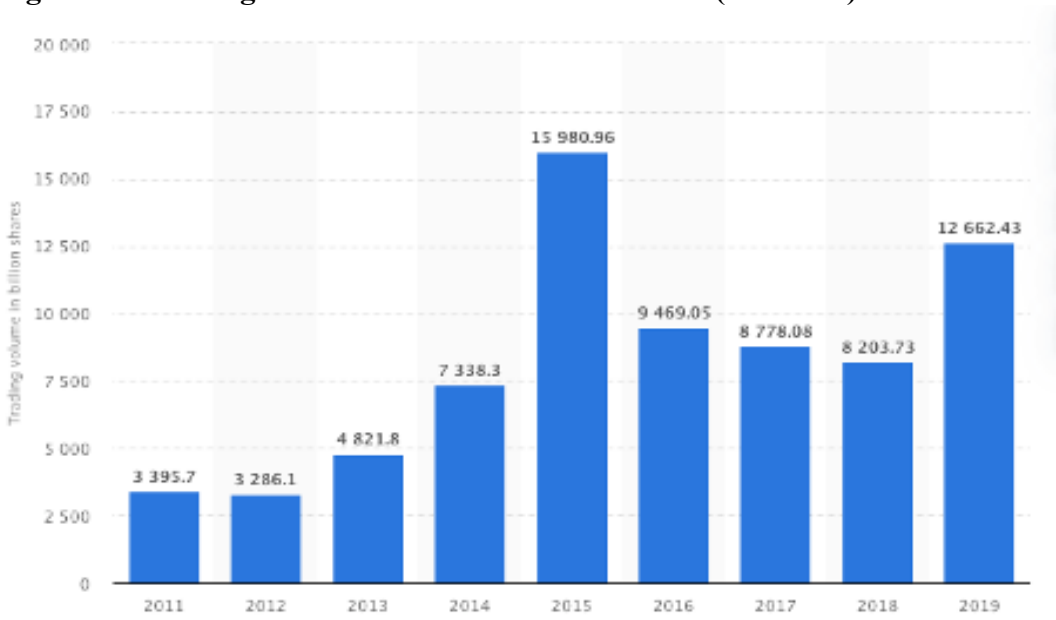
trillion in 2019 and accounted for 59.4% of nominal GDP. It can be seen from Figure 2.4 that trading volume is increasing rapidly from 2011 to 2019. Especially in 2015, the volume has increased by around twice the volume in the previous year. The trading volumes reached around 12.66 trillion shares in 2019, indicating China's stock market flourishing and attracting more investors.

Figure 2.3 Total market capitalization of China's stock market 2012 to 2019 (in trillion yuan)



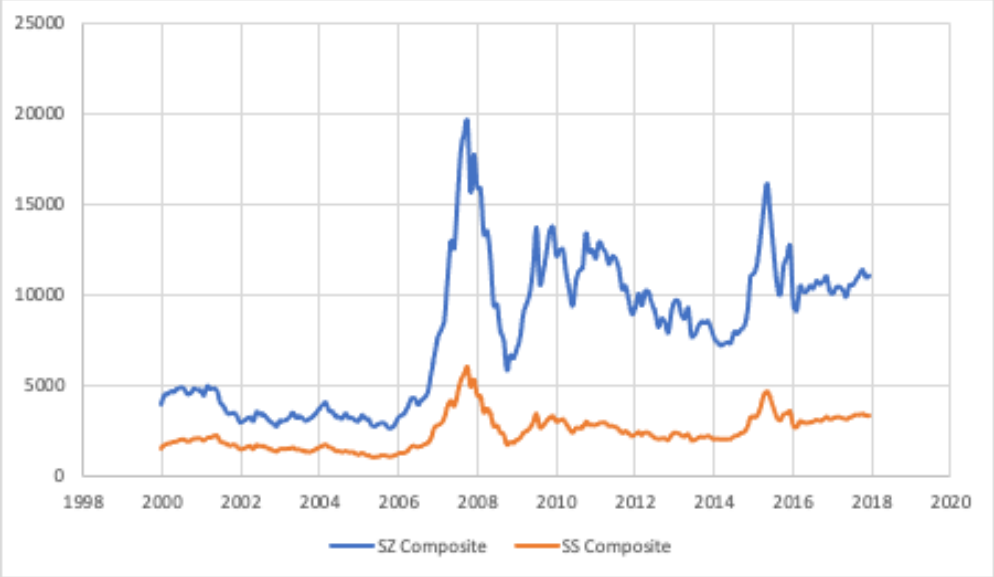
(source: Statista 2020, Available from https://www.statista.com/statistics/235090/market-capitalization-of-listed-companies-in-china/)

Figure 2.4 Trading volume on China's stock market (in billion)



(source: Statista 2020, Available from https://www.statista.com/statistics/458183/china-stock-market-trading-volume/)

Figure 2.5 Shanghai and Shenzhen exchange stock market index over time



(source: Yahoo finance, Avaliable from https://finance.yahoo.com/quote/000001.ss/history/)

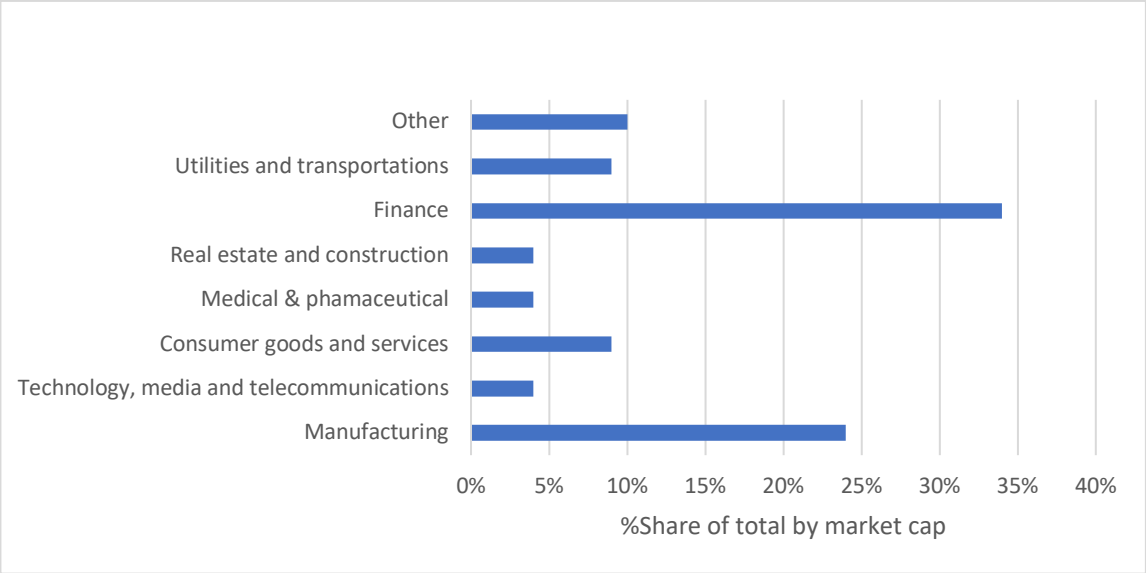
The Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) are the two most important stock markets in mainland China and are governed by the China Securities Regulatory Commission (CSRC). These two main stock exchanges experienced three main events following their earlier formation. The first event was in the late 90's during the Asian financial crisis, which significantly affected the Chinese stock exchanges. Then, in 2007, the global economy was influenced by the subprime crisis and the Chinese stock exchanges were unable to escape its effects, which destroyed two-thirds of its market value, as noted by Schmidt (2009). The highest value for the market was back in 2007, the Shanghai composite index, which represents the market return of the Shanghai stock market, has declined sharply from its peak after the financial crisis.

The Chinese stock market differs to markets in other countries due to the heavy intervention by the government. Over recent years, as the Chinese economy has developed rapidly, the two stock markets have experienced many improvements in management and regulation in order to become more flexible. The Shanghai Stock Exchange was created in 1990 and is a non-profit organization. The SSE aims to set up a transparent, open, reliable and efficient stock marketplace and facilitate the securities trading on the China's stock markets. Regarding the SSE, investors can trade in many financial products, such as shares, bonds and other financial securities. There are A-shares, traded in RMB, and B-shares, traded in dollars or the Hong Kong dollar. The Shanghai composite index represents the trend for the stock returns of the whole market. Meanwhile, the Shenzhen stock exchange, also created in 1990, aims to provide a marketplace for securities trading, applying its regulations and examining the applications of listed companies, whilst organizing and regulating securities trading. In 2005, the Shenzhen stock exchange was the 8th largest exchange in the world with a market captializtion above US$ 2 trillion in 2005.

From Figure 2.6, which shows the percentage share of total shares by market capitalization, it can be seen that the main industries on the Shanghai stock exchange include: finance(24%), manufacturing (24%) and othet industries (9%). Compared with the Shanghai stock exchange, manuafacturing (32%) makes up the largest proportion of the total market capitalization, while technology, media and communications account for 25% and the consumer goods and services sector makes up 18%. Additionally, the Shanghai stock exchange mainly contains larger state-owned companies , which are blue-chip shares , while the Shenzhen stock exchange mainly

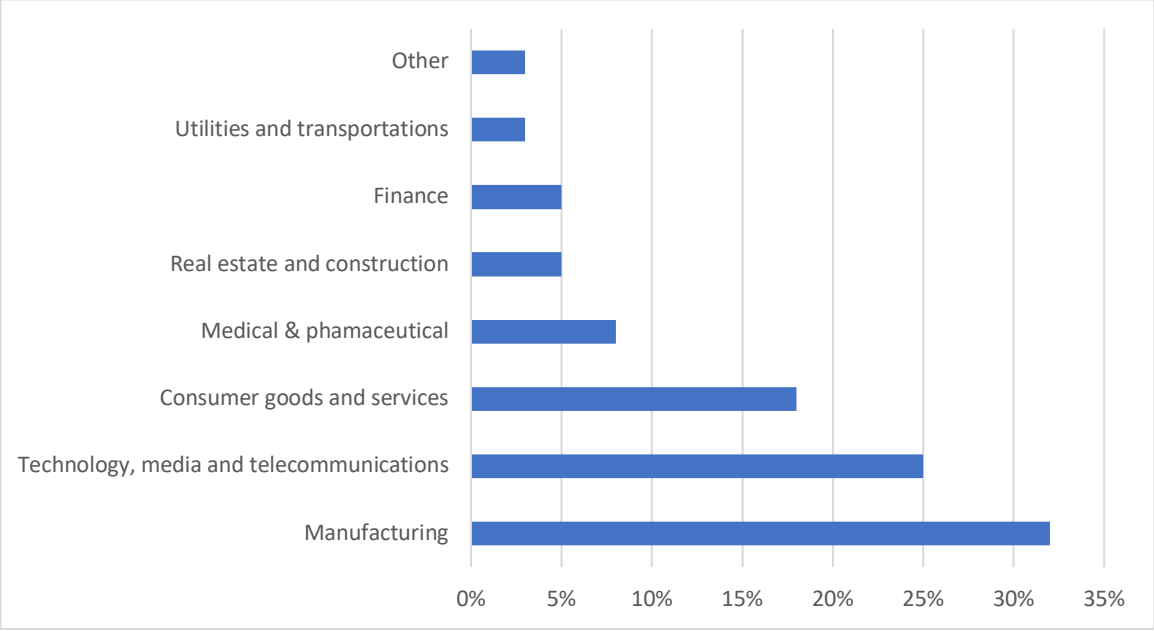
includes mid-cap and small-cap firms, which are more likely to take their own risk management strategies so as to respond to external shock.

Figure 2.6 Shanghai stock exchange in 2016



(source:Financial times, Available from https://www.ft.com/content/ea829cb8-a7f8-11e6-8b69-02899e8bd9d1)

Figure 2.7 Shenzhen stock exchange in 2016



(source:Financial times, Available from https://www.ft.com/content/ea829cb8-a7f8-11e6-8b69-02899e8bd9d1)

2.1.3 The foreign exchange markets

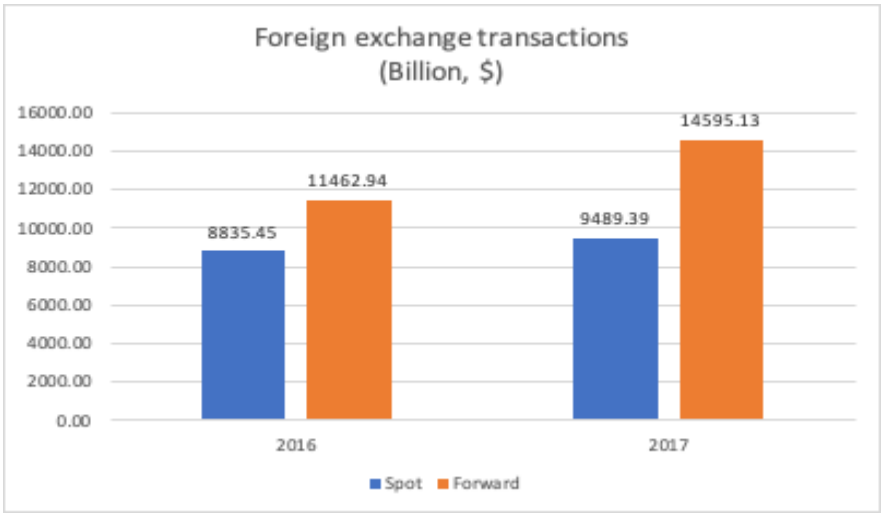
Since the reforms of the exchange rate in 2005, banks and corporations in China have become exposed to increasing exchange rate risks resulting in the increasing use of derivatives to help them with risk management. Gu, Yang and An (2014) demonstrated that the firms face significant foreign exchange exposure when the financial crisis happened by using an event study method. As the use of derivatives can be a double edged sword, it can not only be associated with the reduction of risks but also it could be a threat to the financial market stability as illustrated by a letter written to shareholders by the well known investor Warren Buffet in 2002. Thus, it is necessary for the foreign exchange markets to be developed and regulated with discretion.

In 2010, as the State Administration of the Foreign Exchange (SAFE) further developed the forward settlement process, currency derivatives became more easily accessible to firms. Meanwhile, the exchange also launched foreign exchange options for trading businesses and standardized the RMB foreign exchange forward contracts in 2011 and 2016 respectively. From Jan 2011, the Chinese Banking Regulatory Commission (CBRC) proposed new regulations on the requirements for derivative usage, which further developed the regulatory framework in the foreign exchange market.

In the Chinese foreign exchange market, there are three types of foreign currency derivatives used by banks and firms, these include forward contracts, swaps and options. Foreign exchange forward transactions means that the two parties to the transaction do not deliver immediately, they are obliged to purchase or sell at a specified currency and exchange rate on a specified maturity, such as overnight, one week, one month, two months, three months, six months, twelve months and other periods. The benefit of a forward agreement is to enable firms to mitigate the effect of exchange rate movements by locking in the risk in advance. Foreign currency swaps are the most prevalent in the market and refer to an agreement between the two parties. A common form of this type of derivative is a combination of a spot transaction and a forward transaction. The two parties swap the principal and interest payments of a loan with equal value in their own currency at a specified date. Foreign options offer the buyer and seller the right, instead of obligation, to buy or sell the foreign currency assets at a specified maturity, such as one week, two weeks, one month, three months, one year etc.

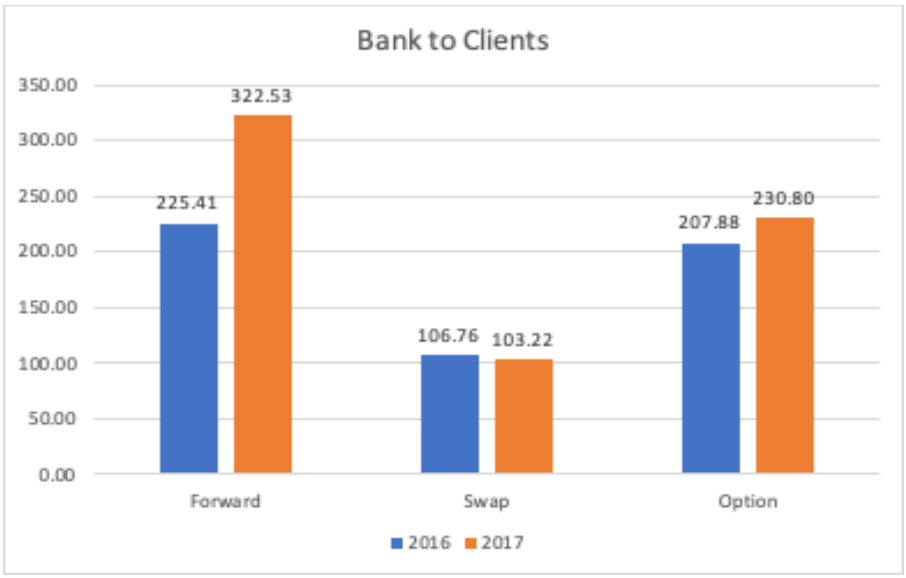
With the progress in the development of the exchange rate regime, the foreign exchange market has been gradually expanding. Foreign derivatives transactions, including bank to bank and bank to clients, reached around 14,595 billion US dollars in 2017. Compared with 2016, the scale of derivatives transactions has expanded by 27% while the scale of spot transactions has only increased by 7%, which can be seen from Figure 2.8.

Figure 2.8 Foreign exchange transactions in China



(source: State Administration of Foreign Exchange of China, Available from https://www.safe.gov.cn/en/DataandStatistics/index.html)

Figure 2.9 The forward exchange transactions by clients from 2016 to 2017 (in billion, US dollar)



(source: State Administration of Foreign Exchange of China, Available from https://www.safe.gov.cn/en/DataandStatistics/index.html)

In particular, focusing on the use of derivatives by clients in Figure 2.9, from 2016 to 2017, except for the use of swap contracts which have been experiencing a slight decrease, the use of forward contracts and options have been increasing by 43% and 11% respectively. It can be illustrated that derivative usage is gradually becoming more prevalent for firms in order to manage their business and risk.

Concentrating on the proportion of each type of derivative used in 2020, it can be observed that the preferences in derivative usage differ between the interbank markets and clients, as in Figure 2.10. The majority of transactions in the interbank market are swaps, which take up 96% of all forward transactions while forward contracts and options account for 3% and 1% respectively. In contrast, the proportion of swap contracts used by clients are 25% and Clients are more likely to use forward currency derivatives, which have taken up 47% of all forward transactions in 2020. The use of options is also relatively common between banks and clients and takes up 28% of transactions.

Overall, the foreign exchange market has developed rapidly over recent years, which has been motivated by the reforms of the exchange rate regime. A more developed market has enabled firms or individuals who are exposed to exchange rate risks to have some useful tools to manage risks and lower any potential loss from adverse exchange rate movements. Furthermore, capital inflows and outflows have been promoted to ensure the capital markets are efficient.

Figure 2.10 The components of derivatives usage in 2020 (in 100 millions , RMB)

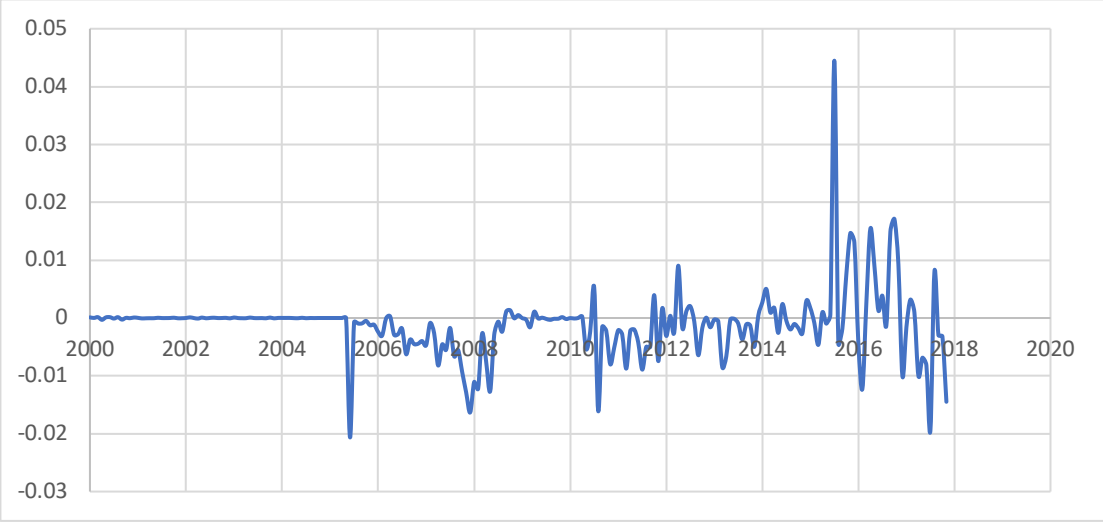
(source: State Administration of Foreign Exchange of China, Available from https://www.safe.gov.cn/en/DataandStatistics/index.html)

2.2 The situation of Chinese firms in the foreign exchange market

2.2.1 The effect of exchange rate changes on firms

As we can see from Figure 2.11, the exchange rate remained stable when the exchange rate was pegged to the dollar. Since the reform of the exchange rate regime in 2005, changes in the exchange rate started to become more prevalent as the exchange rate became more volatile. Due to the shock from the global financial crisis, the reforms of the exchange rate were paused to help firms mitigate their risks. After the recovery from the crisis, firms again faced exchange rate risks along with the restarting of exchange rate reforms. From 2010, the exchange rate began to fluctuate slightly within a relatively stable range until the Renminbi joined the basket of currencies of the special drawing rights. As the Renminbi has become more international from 2016, exchange rates will not be as stable as before and are more volatile than in the past, which could be observed from Figure 2.11. The Chinese exchange rate regime has developed rapidly so that the exchange rate has become as flexible as other developed countries. A flexible exchange rate is beneficial in promoting capital flows to the financial markets but it could also induce larger foreign exchange shocks to firms with the increasing range in exchange rate movements.

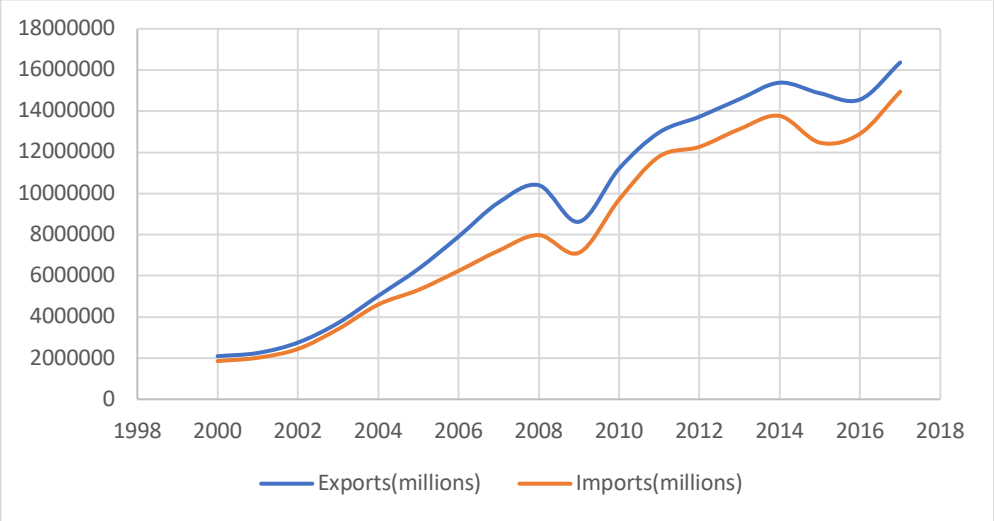
Figure 2.11 The volatility of exchange rates (USD/CNY) over time



(source: International Monetary Fund; International Financial Statistics)

The valuation of the domestic currency against other currencies is critical to the development of the economy. A steady exchange rate enables firms to limit the risks they are exposed to in the foreign exchange markets and it affects the movement of capital flows. Before the reform of the exchange rate, it was fixed to the value of the dollar in order to promote business for exporting firms because they were dominant in the market. Compared with the dollar, the valuation of the renminbi has been at a relatively lower level leading to competitive prices for products sold to other countries. It can be observed from Figure 2.12 that the level of exports has expanded by around 3.5 times from 2000 to 2005 while there is only around a 46% increase after restarting the reforms in 2010. When the exchange rate started to float, the appreciation of the renminbi against the US dollar has had a negative affect on export firms as their products have lost the advantage of price and the costs of goods has increased. As a result, the speed of export expansion has slowed since the exchange rate started to fluctuate. Meanwhile, the costs for importing firms have decreased with the appreciation of the domestic currency, which should improve their profits. In contrast, exporting firms benefit from the depreciation of the renminbi whereas import firms lose profits due to increasing costs. Therefore, it is essential to manage exchange rate risks for firms, not only including firms with foreign business but also domestic firms. Domestic firms are indirectly affected by exchange rates movements through competition with multinational corporations in the market. As the exchange rate regime has become more flexible, banks and financial companies have been able to provide a variety of attractive financial products, which has promoted capital flows. Currency derivatives have been developed in order to help non-financial firms and banks to hedge against exchange rate risks.

Figure 2.12 Exports and imports of goods and services over time



(source:International Monetary Fund; International Financial Statistics; Available from https://www.imf.org/en/Data)

2.2.2 Corporate risk management in China

From the derivatives statistics published by the International Swaps and Derivatives Association (ISDA) in 2009, it was common for over 94% of the world's largest companies to use financial products to hedge against foreign exchange risks. Furthermore, firms in developed countries have appreciated the necessity of taking risk management strategies after the financial crisis. Around 92% of US multinational corporations, including a broad range of industries, employ financial instruments to hedge against financial risks. Also, hedging behaviour could be observed in 97% of firms in Germany. Compared with this popularity in risk management, firms in China have only just started to recognize the importance of risk management and 62% of firms reported that they employed financial derivatives to reduce foreign exchange risk, including a variety of derivatives. Based on a survey by ISDA, foreign currency derivatives are the most popular type of instruments. From Table 2.2, it can be observed that firms in materials makes up the largest proportion of those using derivatives to hedge after the financial industries.

As a result of the distinct monetary policy and exchange rate regime in China, the government had helped importing and exporting firms reduce foreign exchange risks at a country level, which lead to a lack of need for exchange rate risk management before the start of the flexible exchange rate regime. During this time, banks and derivative markets provided only a limited range of products, which made it difficult for firms to access hedging products and caused them higher transaction costs. To secure the stability of the financial markets, the regulation of the derivatives markets had to be set up carefully to ensure firms could obtain hedging derivatives in a safe environment. Furthermore, after the recent changes of regime and the underdeveloped nature of the derivatives markets, executives and managers lacked the expertise to use financial instruments effectively in risk management strategies.

Das (2019) proposed that China's exchange rate has become more flexible than before although it is still managed in the short run. The exchange rate is able to reflect market demand and supply in the long term. To conclude, the exchange rate regime reformation has improved the flexibility of Chinese exchange rates although there are relatively low fluctuations in the exchange rates compared with developed countries. The reform has enhanced the efficiency of the foreign exchange markets, which motivates market participants to forecast or manage foreign exchange risks more effectively. Then hedging instruments should be regulated and

accessible and market participants should be educated in being aware of exchange rate risks and making optimal hedging strategies. Thus, it is important to explore the effects of hedging with derivatives as there is still a long way to go in the development of risk management in China.

Chapter 3

The Underlying Theory On Hedging

As firms face increasingly volatile exchange rates, it is essential to understand the effects of exchange rates movements on firms corporate strategies. The thesis intends to estimate the sensitivity of firm's stock prices in response to the movements in exchange rates and find out whether the level of trade influences the sensitivity under a volatile exchange rate regime. The first step is to find out what kinds of risks firms will experience in the floating regime and the mechanism through which a volatile currency values are affecting firms' business and operations. Then, I would like to determine how firms react to the unexpected effect of exchange rate changes and what factors would motivate them to take hedging strategies. Smith and Stulz (1985) have illustrated that firms can benefit from using hedging instruments, which provides theoretical support for my future empirical studies in Chapter 6 where the firm value effect of the use of foreign currency derivatives is analysed. This Chapter mainly discusses the basic concepts and underlying theory in the thesis. Section 1 describes the concepts of foreign exchange risks and section 2 introduces the way to hedge foreign exchange risks while section 3 provides the underlying theory on a possible valuation effect from hedging in the real world .

3.1. Foreign exchange risk

Foreign exchange risk relates to the affects of changes in the exchange rate on transactions involving more than one currency, defined by Adler and Dumas (1984) who also illustrated the concept of the foreign exchange exposure. Firms engaged in foreign trade or investments may be directly affected by the exchange rate as the costs or revenues would be uncertain at the maturity of the settlement. Firms without foreign businesses and investments may be indirectly affected by exchange rate fluctuations through the effect of competitors' prices. With an appreciation or depreciation of the currency, uncertain gain or loss will affect the firms value leading to a further impact on the firms' operations.

As the volatility of the exchange rate has increased in recent years, firms are likely to meet more challenges and risks than ever before because with a flexible exchange rate it is difficult to anticipate the future. Exchange rate risks refer to changes in the value of assets or liabilities in a currency due to uncertainty of the exchange rate. Due to the development of international

trade, not only are firms with foreign business or foreign financing exposed to exchange rate risk but also domestic firms are indirectly influenced by the competition from foreign markets. There are many factors that could affect the valuation of the domestic currency against foreign currencies. As a result, firms could face a variety of risks caused by exchange rate movements, such as translation risks, transaction risks and economic risks. Translation risks are commonly represented by the gains or losses on foreign exchange assets and liabilities in the accounts. With the rapid development of the economy in China, firms are more willing to invest or set up subsidiaries in other countries which results in differences in accounting when translating foreign currency into renminbi.

Risks occur from the settlement of assets when transacted in a foreign currency, with foreign debts or forward contracts, and are called transaction risks. When the exchange rates are volatile, firms involved in international trade will face the uncertainty of their revenues or costs settled in a foreign currency at a future date. Economic risks refer to the difference between the actual and the expectation of foreign cash flows, which are one of the most important risks in China. With the appreciation of the renminbi, this has been a large shock to exporting firms as it increases the cost of domestic human capital causing a decrease in the financial strength of the firms facing international competition.

3.2 The hedging of foreign exchange risk

As the exchange rate fluctuates, it is essential for non-financial firms to have risk management strategies. Based on Aretz and Bartram (2010), there are two main approaches to hedge exchange rate risks. First, it is called operational hedging such that firms match their foreign currency costs with relatively similar amounts of revenue. Thus, the exchange rate changes would have no effect on the total profits of the firms. The other type is financial hedging, including the use of foreign currency forward contracts, swaps and options. Financial hedging offers an opportunity for firms without paired foreign businesses to hedge foreign exchange risks. Foreign forward contracts enable exchange rate risks be limited in advance as firms specify in the contract what the exact exchange rate will be for the business they need to deliver in the future. Options offer firms the right but not the obligation to execute the contracts, based on the exchange rate at the options maturity. If the exchange rate at maturity is beneficial to the firms, firms would carry out the contract, otherwise the maximum loss is the option fee,

which is limited at the beginning. Thus, financial hedging is useful for firms to hedge against foreign exchange risks but the use of financial hedging is determined by several factors.

A well-developed financial market and foreign exchange markets are fundamental to the use of financial hedging as markets need to be efficient and provide a variety of financial products for firms to choose from. Firms attach much importance to managing exchange rate risks when they experience a flexible exchange rate regime. At the same time, developed markets improve the liquidity of the derivatives transactions and provide a variety of instruments accessible to firms which intend to hedge against exchange rate risks. The general situation and the trend in the macroeconomy would also affect the position of firms when they enter into a foreign currency derivative contract. The firms' characteristics and the expertise of the executives to hedge products also affects the use of derivatives. Furthermore, complicated political factors and the regulations in the market would also influence the use of financial hedging.

3.3 Positive hedging theory

The benefits of hedging are not only limited to risk reduction but they can also be beneficial to the shareholders value, although Modigliani and Miller (1958) proposed that the method of finance is irrelevant to the firm's value in the absence of taxes, bankruptcy costs and agency costs. In the real world, firms need to consider tax benefits by issuing debt, dealing with bankruptcy costs and solving the conflict of interests between shareholders and executives.

Tax

Smith and Stulz (1985, 2001) put forward the theory that one of the determinants of hedging policy is the convexity of the tax function which means that changes in taxes increase more than proportionally the change in taxable income. The theory illustrated by Smith and Stulz (1985) includes the assumption of an increasing function between pre-tax firm value and the marginal tax rates. In the model of Smith and Stulz (1985), they illustrated that the firms with hedging strategies can reduce the volatility of the pre-tax firm value and in turn decrease the expected corporate tax liability. Thus, the expected after-tax firm value has been improved as long as the costs of the hedge do not exceed the tax benefits. They proposed a state-preference model of firm value, letting s indicate the states of the world. The theory assumed the firm experienced a pre-tax value V_i in the state of the world i. The pre-tax firm value in the world i is lower than the pre-tax value in the world j, if $i < j$. P_i represents today's price of one dollar which would be delivered in the state of the world i. $T(V_i)$ will be the tax rate when the firm

has pre-tax value of V_i and then $V(0)$ is taken as the unlevered firm's value after deducting taxes. In the absence of leverage, the model is as follows,

$$V(0) = \sum_{i=1}^{s} P_i(V_i - T(V_i)V_i) \tag{3.1}$$

Smith and Stulz (1985) assumed that there are two states of the world j and k and that the tax rate of the pre-tax firm value V_j is lower than the tax rate of the pre-tax firm value V_k, which indicates that $T(V_j) < T(V_k)$. The theory supposes that if the firm holds hedge portfolios H_j and H_k in each state of the world, the total value in each state, including the pre-tax value plus the value of the hedge portfolio, should be equal. Then,

$$V_j + H_j = V_k + H_k \tag{3.2}$$

If the hedge portfolio is taken as self-finance, then the $P_j\ H_j + P_k\ H_k = 0$. Thus, the firm with the hedging strategies could increase the after-tax firm value by the following:

$$V^H(0) - V(0) = P_j\left(T(V_j)V_j - T(V_j + H_j)(V_j + H_j)\right) + P_k\ (T(V_k)V_k - T(V_k + H_k)(V_k + H_k)) > 0 \tag{3.3}$$

Within the equation, $V^H(0)$ represents the after-tax value of firms with hedged strategies. The Smith and Stulz (1985) model implies that hedging increases the value of the firm as long as the cost of hedging is not too high. The benefit from decreasing the corporate tax liabilities would be offset by the increased tax burden to the investors if hedging is over-costly.

Overall, this model implies that unstable taxable income would lead to a heavier tax burden on the firm than smooth taxable income. In order to lower the corporate tax burden of the firm, hedging strategies smooth the volatility of taxable income resulting in an increasing value for the firm, as has been proposed by Aretz and Bartram (2010). Risks relating to the operating income of the firms could be reduced and mitigated by hedging with derivatives, which suggests that the firm's revenue will be less affected by shocks. Thus, the firm could have a steady operating income and with the convexity of the tax schedule, the reduction in the volatility of taxable income is beneficial to firms by the saving of taxes.

Bankruptcy costs

Bankruptcy costs will occur as the firm with a high leverage is not able to afford debt payments based on the cash flow of the firm. The firms with higher leverage and unstable cash flows are more likely to fall into financial distress than firms with relatively lower levels of debt

financing and stable cash flows. Bankruptcy costs consist of direct costs and indirect costs. The direct costs of bankruptcy, mainly containing the fees for lawyers and administrative costs, are incurred when the firm is in the procedure of insolvency. However, firms would struggle with the indirect costs of bankruptcy before the start of insolvency as stakeholders consider there is a high probability of financial distress in the near future. These costs include the costs of losing suppliers and customers or the higher costs of capital caused by increasing interest rates. Cutler and Summers (1988) illustrated that indirect costs take up a larger proportion of firm value (around 20%) than the direct costs of insolvency, which only account for 1% to 3% of the firm value based on Weiss (1990).

In Smith and Stulz (1985), the model shows the form of hedging that lowers the probability of incurring bankruptcy costs, which would benefit the firm's value. If the firm has debt F, representing the face value of debt, the firm need to deal with bankruptcy costs if the firm value is lower than the debt value at maturity. In this scenario, the bondholders can get a payoff, which equals the face value of the debt minus the transaction costs of bankruptcy. Otherwise shareholders could receive the payoff, which is equal to the firm value minus both taxes paid and the repayment of debt (F). A simple and basic model proposed by Smith and Stulz (1985) supposes that a firm issues debt to enjoy the tax benefit for financing, P_i, V_i, $T(V_i)$, $V(0)$ has the same definition as in the above model, showing that hedging can affect the firm' value through the tax schedule. They assumed a leveraged firm issuing pure discount bonds with face value F. $V(F)$ represents the after-tax value of a leveraged firm, which has the same investment policy and other characteristics as the unleveraged firm. To simplify the model, it assumes that $V_j < F < V_k$ and bankruptcy costs are less or equal to the firm' pre-value, which means that $C(V_i) \leq V_i$ if $V_i < F$. Then the difference in the after-tax value between the leveraged firm and unleveraged firm can be written as:

$$V(F) - V(0) = \sum_{i=1}^{j} P_i(T(V_i)V_i - C(V_i)) + \sum_{i=k}^{S} P_i T(V_i) \tag{3.4}$$

In order to examine the effect of hedging on the firm value through bankruptcy costs, a firm is assumed to hold a hedge portfolio. Assuming that in the state of the world g, the firm has a hedge portfolio paying $H_g < 0$ and in the state of the world m, the firm has a positive hedge portfolio, $H_m > 0$. Also, Smith and Stulz (1985) assume that the hedge portfolio does not affect

the currents cash flows, which means $P_g H_g + P_m H_m = 0$, and $V_g + H_g > F$ and $V_m + H_m > F$, which implies that a hedging portfolio can lower the probability of incurring bankruptcy costs. By construction, $V_g < F$, the difference in after-tax value between firms with hedge strategies and firms without hedging.

$$V^H(F) - V(F) = P_g C(V_g) + P_g T(F - V_g) \tag{3.5}$$

Due to $C(V_g) > 0$ and $V_g < F$, the difference of $V^H(F) - V(F)$ is always positive, which shows that firms get a benefit in firm value from constructing hedging portfolios. Smith and Stulz (1985) also illustrated that it is still profitbale to hedge even with costly hedging as hedging can decrease the bankruptcy costs which are associated with shareholders and bondholders value.

Corporate hedging strategies can be an indicator of the ability of firms to manage risk leading to stable cash flows, which is beneficial in terms of lowering the probability of financial distress to stakeholders. Thus, the firm value is less affected by the costs of bankruptcy through implementing hedging strategies. Meanwhile, corporate hedging is valuable to the firm value by improving a firms' ability to afford higher levels of debt than firms without hedging. As hedging any risks makes the cash flow less volatile, Graham and Rogers (2002) suggested that firms could carry higher debt burdens with an increasingly optimal leverage and enjoy tax benefits from debt financing, which results in an increase in the firms' value.

Agency Costs

Agency costs exist in the real world as different interests are shown by various stakeholders, such as shareholders, executives and bondholders. The payoff from hedging can affect the payoff of stakeholders, which influences the decision to hedge. To illustrate, Smith and Stulz (1985) define H_i as the payoff of the hedge portfolio in the state of the world i so it can be written as,

$$H_i = \sum_j N_j * Q_{ij} \tag{3.6}$$

where N_j shows the number of shares of asset j purchased by the firm, and Q_{ij} represents the payoff of one share of asset j in state of the world i.

The manager's expected utility is determined by the firm's payoff, which can be affected by the hedging portfolio. Assuming that the manager can get wealth W_i at the end of the state of the world i, the expected utility of the manager (U_i) can be written as a function of wealth,

$$U_i = U\big(W(V_i + H_i)\big) \; where \; i = 1, \dots, s \tag{3.7}$$

The model assumes that the utility function is strictly concave, which implies the manager's preference is risk averse. Under certain assumptions, the maximum expected utility of the manager is shown as follows:

$$U = \sum_i P_i * U\big(W(V_i + H_i)\big) \text{ with respect to } \sum_j N_j * Q_{0j} = 0 \tag{3.8}$$

where Q_{0j} is the price of a share of asset j at the beginning of the period of the state of the world. The optimal number of shares can be obtained by taking derivatives of W and the results are shown as follows:

$$\sum_i P_i \frac{\partial U}{\partial W} W' \frac{Q_{ij}}{Q_{0j}} = \sum_j P_i \frac{\partial U}{\partial W} W' \frac{Q_{ik}}{Q_{0k}}, for \; all \; j \; and \; k \tag{3.9}$$

The above first-order conditions indicate that asset j and asset k have equal rates of return, which assumes the same expected rates of return for all financial assets and no transaction costs. In Smith and Stulz (1985), there is an example of firms which do not hedge even though the manager is risk averse. It is assumed that the manager can get a promised payment from the firm, which is equal to $\tau + Max(V_i - K_i, 0)$. Consider a simple model, it is supposed that there are two states of the world, which indicates that $S = 2$ and $V_2 > k > V_1 > \tau$. To maximise the expected utility of the manager:

$$U = P_1 \frac{1}{d} W_1^d + P_2 \frac{1}{d} W_2^d; d < 1 \tag{3.10}$$

Given the assumption that the hedge portfolio does not affect current cashflow,we can have:

$$P_1 H_1 + P_2 H_2 = 0 \tag{3.11}$$

By Replacing H_2 in the expected utility function with $H_2 = (-\frac{p_1}{p_2})H_1$ and taking the partial derivatives with respect to H_1, the model can show that U is a decreasing function of H_1. It implies that a positive hedge has a negative effect on the manager's expected utility, resulting in not using hedging strategies.

Furthermore, based on Aretz and Bartram (2010), agency problems could be a channel for hedging to influence the value of the firms. A firm is a link between different stakeholders, such as managers, shareholders, debtholders and employees (Jensen and Meckling, 1976). Managers are running firms on behalf of shareholders and they take advantage of greater information over the shareholders as they are more engaged in daily operations. The goal of managers is to try to get a high performance regardless of risks, which is not consistent with the goal of shareholders for maximising the value whilst minimising risks. As a result, conflicts between managers and shareholders arise as distinct objectives of stakeholders. Even though the managers compensation scheme is linked to the maximisation of shareholders value, value-enhancing projects will still be abandoned as the profits from projects are mostly beneficial to bondholders. This case is known as the underinvestment problem especially for the firm with high leverage and low value because debtholders have priority in reimbursement over shareholders. Shareholders would not enjoy the gain of value-enhancing projects. To avoid underinvestment problems by reducing the amount of debt outstanding, corporate risk management helps to offset the loss in tax benefits from financing by debt. The volatility of the firm value could be smoothed by hedging risks, which enables shareholders to be less likely to give up on the projects with a positive net present value (Bessembinder 1991; Mayers and Smith 1987).

Moreover, the agency costs will increase because bondholders, who predict the firm's underinvestment, will require a high yield on capital or protective covenants. Smith and Warner (1979) proposed that these costs will be harmful to the value of the firm. Conflicts between shareholders and bondholders arise due to different types of risk aversion. Shareholders expect to obtain the maximum value with minimum risks so they prefer safe projects while bondholders would prefer firms focusing on high risky investments with high profits. Corporate hedging is able to solve this problem by smoothing the volatility of cash flows and reducing the risk exposure of firms. Thus, shareholders are willing to consider riskier assets compared with the situation where firms do not use hedging strategies.

Overall, Smith and Stulz (1985) supported the hypothesis that hedging policy can benefit the firm value through the tax schedules, the costs of bankruptcy and agency costs in an imperfect world provided that the cost of hedging is less than the frictional costs. Based on this positive hedging theory, I proposed the hypothesis in Chapters 5 and 6 relating to the determinants of the use of hedging with currency derivatives in China. The potential financial distress motivates

executives to strengthen their risk controls by employing the foreign currency derivatives to hedge. With the lower risk exposure, firms face less possibility of bankruptcy and attract more investors, which results in a positive valuation effect. Meanwhile, agency costs are caused by the conflict of interests among stakeholders, shareholders, executives and bondholders. As Aretz and Bartram (2010) have argued higher agency costs lead to the underinvestment problem which could be resolved by hedging and in turn the volatility of cash flow can be smoothed. In addition, this study extends the theory of Smith and Stulz (1985) by including asymmetric information which could affecti the use of foreign currency derivatives. The use of foreign currency derivatives could be an indicator of a well-controlled risk system for young firms to attract creditors to invest. The fims with productive investments can create positive earnings resulting in an increasing firm value. Therefore, this study intends to explore whether these factors;financial distress, agency costs and information asymmetry, are the main determinants of the use of currency derivatives for multinational firms in China and whether the firm can benefit from derivative usage through these mechanisms.

Chapter 4

The Estimation And Determinants Of The Foreign Exchange Exposure For Chinese Firms

4.1 Introduction

Since the managed floating exchange rate regime was taken up in China after July 2005, Chinese firms have experienced a new exchange rate environment and as a result face more exchange rate risks than before. Managing the exposure to the exchange rate has become an important area of finance in China in which to learn from the developed Western countries, where floating exchange rate have been in place for many years. Foreign exchange exposure is the main measurement of the effect of floating exchange rates on firm value in Western country studies, such as Dumas (1978), Jorion (1990), Bartram (2008) and Hutson and Laing (2014). Foreign exchange exposure is different to exchange rate risks, which quantify the possibility of the expected exchange rates over or under-estimating the actual exchange rates while foreign exchange exposure estimates the sensitivity of the value of firms reacting to the exchange rate shock. (The difference between currency risk and exposure is explained by Adler and Duma (1984).) Foreign exchange exposure is the first step in studying how to manage exposure to exchange rate changes in a number of studies and it is important to find out the determinants of foreign exchange exposure, which has important implications for managers when deciding on whether to hedge.

Therefore, this chapter analyses the foreign exchange exposure of firms in China following the reforms of exchange rate regime and explores the factors determining foreign exchange exposure. There are two main research questions in this study. Firstly, the study assesses the effect of exchange rate changes on Chinese firms' value from July 2005 to December 2017, which is a relatively long sample period, compared with other Chinese studies related to exchange rate exposure. Following Jorion (1990)'s definition, foreign exchange exposure in this study describes the sensitivity of the value of the firm to exchange rate changes, proxied by changes in the real effective exchange rates. I estimate the contemporaneous and lagged effect of the exchange rate changes on the stock return of listed firms on the SSE by employing a two-factor model (proposed by Jorion (1990)). Around 7.87% of 127 listed firms on the SSE experience significant contemporaneous exposure and 6.3% of the total firms experience a

lagged effect from exchange rate changes. The majority of firms have a negative exposure to the real effective exchange rate changes, which suggests that the value of the firm decreases with the appreciation of RMB.

The second research question in this study is what factors determine the magnitude of foreign exchange exposure. The study plans to answer this question by using a cross-sectional analysis based on the estimated exposure in the first step. This phase aims to examine the relationship between firm specific characteristics, such as the size and the liquidity of firms, and the size of estimated foreign exchange exposure and test whether the exposure is related to the level of foreign trade. The results of this study indicate that the degree of foreign involvement is significant and positively related from 2012 to 2017 but not the sub-period from July of 2005 to 2011. This suggests that the firms with more foreign operations are more likely to be exposed to changes of the local currency value.

Meanwhile, because the Chinese stock market has become more efficient after removing the ban on short selling and margin trading, the prices on the stock market can reflect more efficiently the economic information to managers and investors and allow them to trade and use derivative products more freely. As a result, the level of foreign trade is significantly related to the effect of exchange rate changes on the firm in China post-2011. Overall, the main finding in this study suggests that approximately 7.86% of 127 listed firms on the SSE are exposed to the changes in the value of the RMB and also I find a link between foreign operations and the exchange exposure of the firm in the second sub-period.

The contribution of my work to the existing literature are mainly through three channels. First of all, I am re-examining the relationship used in Jorion's US based study although using the same approach but with Chinese data following the reforms of the exchange rate regime and including additional control variables such as liquidity and size. Secondly, the study uses A-share listed firms on the SSE to estimate firm-level exposure instead of employing firms from manufacturing industries or specific sub-industries as in other Chinese studies. Additionally, I examined the lagged effect of the exchange rate changes on the Chinese firm's value, due to Amihud and Levich (1994), who illustrated that the contemporaneous exchange rate could have little significance on U.S firms' value. The third contribution of my work is, through the results of the changes of the relationship between the level of foreign involvement and the magnitude

of foreign exchange exposure in two sub-periods and this is the first-time of accounting for the liberalisation of the Chinese stock market since 2012.

This chapter is divided into six parts. Section 1 is an introduction and section 2 discusses the previous literature relating to the foreign exchange exposure of Western countries and Asian Countries. Section 3 describes the methodology we need to apply and the data description is presented in the section 4. Then, section 5 analyses and explains the empirical results and there is a short conclusion in the last section.

4.2 Literature review

4.2.1 Literature relating to foreign exchange exposure

Literature relating to the definition of foreign exchange exposure

Since the floating exchange rate regime was applied to the main economies, the effect of exchange rate changes has become a popular topic to study. The early studies recognized the importance of the effect of exchange rate changes on the performance of firms, such as Heckerman (1972). They found that not only did firms with foreign operations experience exchange rate risk but also domestic firms, as they for example may need to import foreign produced components. Meanwhile, Adler and Dumas (1984) showed that both firms with foreign operations and domestic firms are exposed to exchange rate risk because domestic firms faced competition from firms with foreign operations influenced by changes in the exchange rate. Hutson and Stevenson (2010) examined thousands of firms among 23 developed countries and found that firms are more exposed to the fluctuations of the exchange rate when the economy is more open, after controlling for the industry level, firm size, quick ratio and several firm-specific variables.

Some studies have concentrated on the effect of changes in the exchange rate on firms' value and then developed the definition of exchange rate exposure. Dumas (1978) first gave a definition of the exposure of trading firms to the exchange rate, which was estimated using the level of the fluctuations in the exchange rate and the amount of foreign transactions that firms made. The exposure contains two parts. The first part is related to past decisions on the quantities traded and the current price and the other part indicates the effect of exchange rate changes on price movements and the firm's decision to trade. The limitation of his definition is that it can only be applied to the situation when the mean-variance objective function is used.

Then, Adler and Dumas (1984) developed the definition of exposure in general and distinguished between exchange rate exposure, which measures the sensitivity of the real value of the firms' responding to changes in the value of the domestic currency, from the currency risk which refers to its statistical quantities.

Literature relating to the methodology for estimating foreign exchange rate exposure

A. The method using cash flows

Most of the theoretical studies, related to examining the effect of exchange rate changes on the firm value, have usually employed the cash flows of non-financial firms to estimate foreign exchange exposure, such as Shapiro (1975). Hekman (1985) defined the foreign exchange exposure as the elasticity of value of the investment cash flow responding to the changes in future exchange rates and he developed a theoretical model to estimate foreign exchange exposure and to test the value of cash flows and foreign revenues. Booth and Rotenberg (1990) also defined the degree of stability of cash flows affected by exchange rate fluctuations as the exchange rate exposure of firms. Then some empirical studies developed a model to estimate foreign exchange exposure by measuring the changes of cash flows to exchange rate shocks, including operating cash flows, investment cash flows and financial cash flows. Bartram (2008) used proprietary cash flows (CF_t) to represent the non-financial firm value and estimate the relationship between exchange rate changes ($R_{FX,t}^{(i)}$) with an in-depth analysis using the following regression,

$$CF_t = \alpha + \sum_{i=1}^{N} \delta_i R_{FX,t}^{(i)} + \phi_1 R_{ST,t} + \phi_2 R_{DS,t} + \varepsilon_t \qquad (4.1)$$

$R_{ST,t}$ represents the interest rate in the short term and $R_{DS,t}$ means the ratio of the difference between long-term interest rates and short-term interest rates to one plus the long-term interest rate. δ_i is the estimator of foreign exchange exposure, capturing the sensitivity of a firm's cash flow corresponding to the fluctuation of exchange rates.

Gu, Zhang and Zheng (2013) employed a polynomial distributed lag (PDL) model, as proposed by Almon (1965), to estimate the lagged effect of the exchange rate on firm's cashflow including some control variables, such as the short-term interest rate (IR_t), the producer price index (PPI_t). The model is estimated using the following regression,

$$CF_{jt} = c_j + \left[_{q=0}^{8}\omega_j(q)X_{t-q}\right] + \theta_j IR_t + \lambda_j PPI_t + u_{jt} \quad (4.2)$$
$$q = 0,1,2,\dots,8; \quad j = 1,2,\dots,104$$

In the model, CF_{jt} represents the cash flows of firms and Gu, Zhang and Zheng (2013) examined the effect of exchange rate fluctuations on the operating cash flows, investment cash flows, financial cash flows and total cash flows respectively. $_{q=0}^{8}\omega_j(q)$ is the estimator of the lagged foreign exchange exposure where q refers to the lag phase and X_{t-q} represents the exchange rate changes with q lags.

The advantage of the cash flow method is that it allows us to decompose total foreign exchange exposure into the long-term exposure and shot-term exposure. However, as Xu and Wang (2013) pointed out, the foreign exchange exposure is the sensitivity of the value of firms, which is the discounted value of future cash flow, to the exchange rate changes, whereas the cash flow methods only focused on the past cash flows of firms.

B. The method using stock returns

Most empirical studies tend to use stock returns to proxy for the value of the firm due to the unavailability and complexity of the cash flow data of firms, especially in emerging markets. The measurement of exchange-rate exposure has been initiated by Dumas (1978), and involved the regression of the value of the firm on the spot exchange rate and the coefficient of the exchange rate measures the exposure to exchange rate risk which is suitable when a mean-variance objective function is being used. Adler and Dumas (1984) applied the principal of exposure to market risk to the idea of foreign exchange rate exposure, which uses the coefficients obtained from regressing the firm value on the exchange rate. The exposure can be estimated by the following regression,

$$R_{it} = \alpha_0 + \beta_{1i}R_{st} + \varepsilon_{it} \quad (4.3)$$

where R_{it} is the rate of the common stock's return for each firm and R_{st} is the rate of change in the exchange rate, β_{1i} is the exposure elasticity as the responsiveness of a firm's stock return to changes in the exchange rate. Then, based on Adler and Dumas's measurement, Jorion (1990) developed this model in an empirical setting and found that the analysis of foreign exchange

exposure relating to the changes in the value of net monetary assets and real assets held by multinationals, responded to the variations of the exchange rates. He employed a two-factor model to measure the exposure of U.S. multinationals by regressing the rate of return of the common stock on the exchange rates and trade-weighted market returns. The specification is represented by the following equation,

$$R_{it} = \beta_{0i} + \beta_{2i}R_{st} + \beta_{3i}R_{mt} + \eta_{it}, \qquad t = 1, \dots, T \tag{4.4}$$

where R_{mt} is the rate of market return on the CRSP value-weighted market index. β_{2i}, the coefficient of exchange rate movements, which estimates foreign exchange rate exposure. The majority of recent studies have applied this model to their research in order to estimate the exposure, such as Choi and Prasad (1995), He and Ng (1998), Allayannis and Ofek (2001) and Huston and Laing (2014). Then, He and Ng (1998) also considered the stock return and its effect on exchange rate dynamics with a time lag, so they estimated the lagged exchange rate exposure of Japanese firms in the following regression,

$$r_{it} = \beta_{i0} + \beta_{ix}r_{xt} + \beta_{ix}^{L}r_{xt-1} + \beta_{im}r_{mt} + \epsilon_{it} \tag{4.5}$$

The estimated β_{ix}^{L} measures the effect of the lagged exchange rate on the stock return of firms while they found contrary results to the U.S. studies by Bartov and Bodnar (1994) illustrating that firms have significant lagged exchange rate exposure.

Bodnar and Wong (2003) considered the β_{1i} as the total foreign exchange exposures and took the parameter β_{2i} as the residual exchange exposures for U.S. firms after controlling for the affect of stock market returns and employed monthly overlapping observations to estimate the exchange rate exposure over a longer horizon. They found that the increasing return horizon lead to a more accurate estimate. Doidge, Griffin and Willianmson (2006) made a contribution to the research related to foreign exchange exposure by applying a portfolio approach to measure the economic importance of exposure. Most of the studies estimated the linear exchange rate exposure, however, Bartram (2004) first proposed examining the nonlinear foreign exchange exposure of German firms. The general regression based on Adler and Dumas (1984) is shown as follows,

$$R_{jt} = \beta_{0i} + \chi_j f(R_{st}) + \beta_j R_{mt} + \eta_{jt}, \qquad t = 1, \dots, T \tag{4.6}$$

The difference between nonlinear and linear estimates is the nonlinear functional form of the exchange rate. Specifically, Bartram (2004) employed the following model to estimate the asymmetry of exchange rate exposure,

$$R_{jt} = \beta_{0i} + \chi_j R_{St} + \beta_j R_{mt} + \varepsilon_{jt} \tag{4.7}$$

$$\frac{\varepsilon_{jt}}{\sigma_{\varepsilon_{jt}}} = \delta_j + \phi_j Z_{St}^- + \lambda_j Z_{St}^- R_{St} + \omega_j Z_{St}^+ R_{St} + \vartheta_{jt} \tag{4.8}$$

$$\text{with } Z_{St}^- = \begin{cases} 1 \ if \ R_{St} < 0 \\ 0 \ otherwise \end{cases} \text{ and } Z_{St}^+ = 1 - Z_{St}^-$$

R_{St} represents the shock of the exchange rate change, R_{jt} refers to the stock return of the individual firm. He identified differences between the appreciation and the depreciation of domestic currency with bilateral exchange rates and multilateral exchange rates. Meanwhile, Bartram (2004) believed that exposure may not be symmetric due to firm specific characteristics and risk management strategies and discovered that the foreign exchange exposure is significantly determined by the level of the foreign involvement and the liquidity of the firm.

4.2.2 Foreign exchange exposure in developed and emerging economies

Most of the literature so far has used US data or data from developed countries to estimate the exchange rate exposure of firms with fewer studies on emerging economies, such as China, India and Thailand. This part is going to present literature related to developed economies and emerging economies respectively.

Developed economies

These studies have concentrated on foreign exchange exposure at the firm level, industry level and country level. Jorion (1990) firstly defined the sensitivity of exchange rate movements to a firm's stock return as foreign exchange exposure, estimated by his two-factor model at the firm level. He found that 15 out of 287 firms, around 5% of the U.S. multinationals, have a significant foreign exchange exposure during the sample period, from January 1971 to December 1987. Meanwhile, the level of foreign involvement is significant to the foreign

exchange exposure in both subperiods and the full sample period. Following Jorion's two-factor model, Choi and Prasad (1995) also investigated the sensitivity of U.S. multinationals to exchange rate fluctuations. They used 409 multinational firms with complete information from 1978 to 1989 and found 61 out of the total (14.9%) exhibited significant exchange exposure at the 10% significance level under a two-tailed test. Furthermore, 64% of firms with significant exchange rate exposure have the inverse relationship between the value of the dollar and the stock return of the firm, which means that the stock return increases as the dollar depreciates. Instead of using generalized least square (GLS), Choi and Prasad (1995) employed ordinary least square (OLS) to estimate the exposure of individual firms to attain better economic information but under potential econometric inefficiency. He and Ng (1998) examined 171 Japanese multinational's foreign exchange exposure and found that there is no significance effect from the lagged effect of exchange rate movements on firm value. They also further examined the determinants of exchange rate exposure among a variety of industries in subsample periods, including the export ratio and factors related to hedging policies. Bodnar and Wong (2003) employed the Adler and Dumas model to estimate total exposure at the firm-level and the two-factor model, including market return, to measure the residual exposures of U.S. firms. Bartram (2004) studied the exchange rate exposure of 447 German firms to identify the linear and nonlinear foreign exchange exposure from 1981 to 1995 and he found that most of the German firms experience significant exchange rate exposure under different exchange rate indices. He also found that there is a significant nonlinear exchange rate exposure during sample periods and considered that nonlinearities are derived from the operational cash flow that are nonlinear relative to the change of exchange rate.

Hutson and Laing (2014) examined 953 non-financial companies from the New York Stock Exchange (NYSE), American Stock Exchange (AMEX) and NASDAQ during 1999-2009. They employed Jorion's model to estimate exchange rate exposure and found 5.2% of sample firms experienced significant foreign exchange exposure at the 5% significance level. Their results also showed that the number of firms with negative exposure to exchange rate movements is larger than firms with positive exposure. They used the US dollar nominal trade weighted index to estimate exchange rate movements, which means that an increase in the index's value will lead to an appreciation of the dollar. In this case negative exposure to exchange rate movements indicates that the appreciation of the dollar could result in a loss of stock return.

Some studies have concentrated on the differences in foreign exchange exposure between industries. Hutson and O'Discoll (2010) estimated exchange rate exposure among industries and considered firm-specific factors and macroeconomic factors in the regression. Bartram, Brown and Minton (2010) studied the effect of fluctuations of the exchange rate on stock returns based on a specific industry of six countries, the automobile sector, but failed to examine the direction of the expected exposure.

The results of estimating foreign exchange exposure differ across studies. Some research has indicated there is no significant effect of exchange rate exposure. A study illustrated by Amihud (1994) showed that the contemporaneous exchange rate changes could not significantly affect U.S. exporter's stock return during the sample period from 1979 to 1988. Bartov and Bodnar (1994) stated that there is no correlation between the rate of return on common stocks of the firms with overseas operations from 1978 to 1990 and the change of exchange rates and explained that stock markets would not respond to the shock of the exchange rate immediately. Griffin and Stulz (2001) examined the economic significance of exchange rate shocks to the stock returns of industries across six countries from 1975 to 1997, including the United States, Canada, the United Kingdom, France, Germany and Japan. They concluded that random shocks from the exchange rate are of little importance to the industry excess returns while shocks to industries across countries are more important due to the fluctuations of the exchange rates.

However, some studies have shown that the export ratio, indicates the level of the foreign involvement, is a significant determinant. Jorion (1990) found that there were significant cross-sectional differences in exposures among multinationals and then analysed the determinants of the exposure. This paper indicated that the exposure is positively and significantly correlated with the degree of foreign involvement of firms.

Overall the empirical evidence shows that the significance of exchange rate exposure is ambiguous and therefore most studies focus on the source of exchange rare exposure and develop models of the determinants of exchange rate exposure. Dumas (1978) employed techniques to decompose the total value of the firm into an analysis of the determinants of exchange-rate exposure. He and Ng (1998) examined the relationship between exposure and firm specific factors that could influence the decision to hedge against exchange rate unpredictability. Bodnar, Dumas and Marston (2002) developed a duopoly model to examine

the relationship between pass-through behaviour and exchange rate exposure among exporting firms across industries. There is no empirical evidence to prove that the real foreign currency elasticity of exporting firms is underestimated by the exposures measured by regressing stock returns. Bodnar and Wong (2003) found that model structure and return horizon play an important role in the empirical research based on a large sample of U.S. firms over 20 years. They also stated that both the level of statistical significance of exchange rate exposure and the magnitude of the exposure increased as the length of the return horizon increased beyond one month, which means that overlapping estimation techniques are more meaningful. Meanwhile, Bodnar and Wong (2003), Dominguez and Tesar (2006) recognized the importance of controlling variables in the model, such as macroeconomic factors, and found an inverse relationship between exchange rate exposure and firm size. Dominguez and Tesar(2006) included several control variables in the regression used to estimate exchange rate exposure, such as international status, foreign sales, size, trade and competences and they found these control variables are correlated with exchange rate exposure at the industry level.

Emerging economies

Other studies have focused on examining exchange rate exposure in emerging markets. Dominguez and Tesar (2006) estimated the sensitivity of stock returns to exchange rates movements of 8 non-U.S. industrialized and emerging markets over a long sample period, around 20 years, such as Chile and Thailand. They employed the Generalized Method of Moments (GMM) model to estimate the relationship between exchange rate movements and different return horizons, such as 1-, 4-, 12-, 24- and 52-week stock return and found that the exchange rate exposure is increasing with the rising return horizon, while the exposure of Japan is peaking at the quarterly horizon. Meanwhile, the findings of Dominguez and Tesar (2006) showed that the majority of Thai firms exhibit a negative exchange rate exposure to the depreciation of the domestic currency.

Many Asian countries are experiencing with an emerging economy. Parsley and Popper (2006) found that many firms in Asian countries, containing Hongkong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand, are significantly exposed to the exchange rate movements and they discovered that the highest exchange rate exposure of firms existed during the Asian crisis period. Compared with firms in developed countries, firms in emerging economies are more likely to be exposed to the fluctuation of the domestic currency value. The

studies related to emerging economies also include Chue and Cook (2008), who have concentrated on estimating the foreign exchange exposure of 15 emerging markets by using instrumental-variable methods from 1999 to 2006. They found similar results in the first sub-period as to what Dominguez and Tesar found for Thailand but the negative exposure changed into positive exposure to the depreciation of local currency. Testing manufacturing firms with steady increases in foreign trade in Korea, Bae, Kwon and Park (2018) focused on cash flow methods and found that the value of Korean firms is significantly sensitive to the fluctuation of the exchange rate, which is closely related to the use of hedging instruments, such as derivative products. They also showed that the efficiency of hedging depends on the direction of the foreign exchange exposure.

There are only a few studies that focused on estimating the effect of exchange rate exposure in China, since the reform of exchange rate regime started in July of 2005. At the firm level, Luo and Jiang (2007) used a total of 1364 Chinese firms, collected from the Shanghai stock exchange (SSE) and Shenzhen stock exchange (SZSE) stock markets, to estimate the daily effects of changes of the exchange rates on daily stock returns with an augmented market model after the reform of the exchange rate regime, from 2005 to 2007. The empirical results indicate that the market stock return is significantly sensitive to the exchange rate changes. Also, the evidence showed that the proportion of firms in each stock market benefiting from an appreciation of the RMB is larger than the proportion of firms that have experienced a negative exposure to the appreciation of the RMB. Gu, Zhang and Zheng (2013) employed a polynomial distributed lag model to measure the effect of exchange rate changes on the cash flows of 104 firms in the machinery sector from 2003 to 2011. They found that the exchange rate fluctuations had a significant effect on manufacturing firms in the long term. Also, they found that the value of the RMB is negatively related to total cash flows, operational cash flows and investment cash flows but positively related to financial cash flows. Furthermore, the foreign exchange exposure to operational cash flows dominates exposure to total cash flows. Meanwhile, they studied the determinants of foreign exchange exposure and the results indicated that the firm size is positively related to foreign exchange exposure due to the lack of hedging strategies and the exposure increased with the rise in the quick ratio. Therefore, the characteristics of firms are closely related to the magnitude of foreign exchange exposure.

Zhao and Wang (2013) found that the proportion of firms with significant foreign exchange exposure when they employed a non-parametric model is higher than when employing the

linear and nonlinear model to measure it. Also, they found the majority of firms would have a negative effect from the appreciation of the RMB while only a few firms benefited from the appreciation of the domestic currency. Furthermore, they examined the relationship between foreign exchange exposure and the firm's characteristics, such as the firm's openness, size, the growth ability and the debt paying ability. They found the firm size and export ratio are positively related to foreign exchange exposure while the more long-term debt led to less foreign exchange exposure. Gu, Wang and Ma (2016) examined the foreign exchange exposure and its determinants of a total of 51 listed companies from the textile sector, from July of 2005 to December of 2014. They found that most companies in the textile sector experienced benefits from a depreciation of the RMB but only 23.5% of the sample have a significant foreign exchange exposure. They also found that firms experienced asymmetric shocks from the fluctuation of the exchange rate, which can be explained by an asymmetric price strategy, Pricing to market (PTM), due to the low market power of Chinese textiles in the International market. They employed the logistic model and found that the higher export ratio and the lower size of the firm is positively related to the foreign exchange exposure and firms that don't use hedging strategies are more likely to be exposed to changes in the exchange rate.

Some studies have focused on estimating the foreign exchange exposure at the industry level. Based on a panel data analysis, Liu and Yang (2010) used the Fama-French (1993) three-factor model to examine the foreign exchange exposure of 18 sub-industries of the manufacturing sector with variables, including exchange rate movements, a market return index, the size of the firm and its ratio of book value to market value. They discovered that there is at least one co-integrating relationship between the variables and then employed a fixed effects model to study individual effects of the sub-industries and found 15 out of 18 sub-industries exhibited significantly negative foreign exchange exposure, which means that firm value would decrease with the appreciation of the RMB. In general, significant exchange exposure exists in the industries with cycles, such as transportation, while the stable industries without obvious cyclic behaviour, such as food manufacturing, has an insignificant exchange rate exposure. Ni and Ni (2010) discovered that 56% of industries are significantly affected by changes of the exchange rate and as the RMB appreciates industries experience negative exchange rate exposure. In particular, competitive industries, such as manufacturing and other exporting industries showed a high-level of foreign exchange exposure.

Xu and Wang (2013) used 14 Chinese industries from the Dow Jones CBN China 600 sector Blue-Chip Indexes to estimate the exposure of the stock changes and the volatility of exchange rates while using the generalized autoregressive conditional heteroskedasticity methods, GARCH (1,1). The results showed that 6 industries witnessed significant exchange rate exposure to exchange rate changes and two of them benefited from the increase of the RMB value while other firms stock returns decreased with the appreciation of RMB. Gu, Yang and An (2014) examined the exchange rate exposure of various industries based on the event study method. They found that 11 out of 13 industries exhibited significant exchange rate exposure during the event of the RMB exchange rate reformation in 2005 while only 7 out of 13 industries showed significant exchange rate exposure as the RMB exchange rate reformation restarted in 2010. The results suggest that the use of hedging strategies for exchange rate risk is efficient and help industries reduce the foreign exchange exposure.

Zou and Luo (2017) focused on the foreign exchange exposure of 10 industries and found that it showed significant exposure in 7 industries; raw materials, main consumption, financial services, techniques, medicine, engineering and telecom businesses, but foreign the exchange exposure of energy, optional consumption and public businesses were not significant. This result is similar to what Xu and Wang (2013) found. Moreover, the stock return of 10 industries would first go down and then increase as the RMB depreciates. This result can be explained by the J-curve effect. Due to the sticky behaviour of production and consumption, the volume of exports and imports will not change much at first. As a result, the industry experienced a negative effect from the depreciation of the RMB to begin with and then the stock return of the industry increases as the volume of export products rises.

The limitations experienced by previous studies related to China could be due to the lack of the lagged effect of the exchange rates and the lack of estimation of the asymmetric exposure. Luo and Jiang (2007) only measured the foreign exchange exposure and Liu and Yang (2010) did not consider the relationship between foreign trade and exchange rate exposure. Also, the majority of studies focused on a specific industry or did estimation at the industry level with market indexes, such as the manufacturing industry. Therefore, this study aims to expand the literature by testing the contemporaneous and lagged effect of foreign exchange exposure under firm-level data for the Shanghai stock market. Moreover, I am going to split the sample periods based on the development of the Chinese stock markets to find out the recent determinants of foreign exchange exposure.

4.2.3 Literature relating to trade and foreign exchange exposure

It would be expected that foreign trade is positively related to foreign exchange exposure. The firms with more overseas business are more likely to be exposed to the shock of exchange rate changes. A study by Bodnar and Gentry (1993) examined the ratio of foreign assets to total assets and foreign exchange exposure of U.S. firms and found it is one of the main determinants of foreign exchange exposure. Jorion (1990)'s study indicated that the degree of foreign involvement, measured by the ratio of foreign sales to total sales, is significantly and positively related to the foreign exchange exposure of U.S. multinationals from 1971 to 1987. He and Ng (1998) examined the link between the foreign exchange exposure of Japanese multinationals and firm specific factors, such as the level of international operations, firm size, liquidity and the use of foreign currency derivatives. They discovered that the level of the international operations is one of the main determinants of foreign exchange exposure and the exposure of firms increased with the rise in a firm's size. Meanwhile, Bartram (2004) using German data from 1981 to 1995 postulated that the foreign exchange exposure is determined by the proportion of foreign sales to total sales and the firm's size.

Instead of focusing on the developed economies, I use an emerging economy in this study, as only a few studies have concentrated on the determinants of foreign exposure in emerging economies. Hu and Wang (2005) examined Hongkong firms to explore the drivers of currency exposure hedging. Gu, Wang and Ma (2016) provided evidence on the determinants of exchange rate exposure but theyonly focused on the textile and garment industry. Shuai et al.(2018) included the level of foreign trade as one of the main determinants of foreign exchange exposure and found no evidence of the export ratio on foreign exchange exposure using annual data from 2013 to 2016.

Overall, the previous literature relating to foreign exchange exposure is plentiful on developed countries, such as Jorion (1990), Choi and Prasad (1995), Allayannis and Ofek (2001), Hutson and O'Driscoll (2010), Allayannis, Lel and Miller (2012) and Huston and Laing(2014). Only a few studies hove analysed emerging makets. Hardly any studies have focued on China and they provide only a limited evidence using a variety of industries. This empirical study intends to provide evidence on the foreign exchange exposure in an emerging economy and extends the sampling by including listed firms of non-financial firms over a long period. As China has a unique exchange rate regime where exchange rates are not as flexbible as in the US, it is

expected that the stock prices would not react as quickly to the exchange rates movements based on financial markets which are heavily controlled. Thus, in order to fill the gap in the research on emerging markets, this study aims to provide evidence through examining the sensitivity of stock prices to the exchanges rate fluctuations for Chineses firms under a managed-floating exchange rate regime and explore the determinants of foreign exchange exposure.

4.3 Methodology

4.3.1 The foreign exchange exposure

(1) The contemporaneous foreign exchange exposure

The first stage of this study is to measure the foreign exchange exposure, which is the sensitivity of the rate of common stock return on each firm to the change of the exchange rate, as illustrated by Dumas (1984). Then, Adler and Dumas (1984) only considered the relationship between the stock return and the exchange rate without controlling for the market movements. Based on their model, Jorion (1990) modified the specification and illustrated the two-factor model, which took market movements into account. The regression specification is,

$$R_{it} = \alpha_{0i} + \beta_{0i} ER_t + \gamma_{0i} R_{mt} + \eta_{it}, \qquad t = 1, \dots, T \tag{4.9}$$

A number of studies have employed Jorion's model, such as Choi and Prasad (1995), He and Ng (1998), Doidge, Griffin and Williamson (2006), Dominguez and Tesar (2006), and Hutson and Laing(2014). In the regression model, t is the whole sample period, which starts in January 2005 and ends in December 2017 in this study. R_{it} is the rate of return on each firm i's common stock, which represents the value of the individual firms in the market; R_{mt} is the value-weighted market stock index, measured by the Shanghai stock exchange market index; ER_t indicates the changes of the exchange rate, which can be represented by the bilateral exchange rates, the real effective exchange rates or the nominal effective exchange rates; R_{mt} is the value-weighted market stock index, as measured by the Shanghai stock exchange market index; β_i is the foreign exchange exposure, defined by Adler and Dumas(1984) and Jorion (1990), and measures the sensitivity of firm value to the exchange rate movements; if the β_i is positive, the stock return increases as the exchange rates rises. γ_i is a parameter that measures the sensitivity of the market corresponding to the change in the stock prices, η_{it} is the white noise error term.

The first stage uses this regression to test whether the fluctuations of the foreign exchange rate significantly affects the value of the firms in terms of the stock market and measures the foreign exchange exposure of the sample. The null hypothesis is $H_0: \beta_i = 0$ and the alternative hypothesis is $H_0: \beta_i \neq 0$. If the null hypothesis is rejected, the results means that the firm is significantly exposed to the changes of the exchange rate. The value of β_i measures the magnitude of the foreign exchange exposure and the sign of β_i indicates the direction of the effect due to the change in the exchange rate.

(2) The lagged foreign exchange exposure

Some studies, such as Bartov and Bodnar (1994) illustrated that the stock return reflects the fluctuation of the exchange rate with a time lag. He and Ng (1998) examined the lagged effect of the exchange rate changes and so in this study, I follow their regression to estimate the lagged foreign exchange exposure. The regression is the following,

$$R_{it} = \alpha_{1i} + \beta_{1i} ER_t + \beta_i^L ER_{t-1} + \gamma_{1i} R_{mt} + \varepsilon_{it}, \qquad t = 1, \dots, T \tag{4.10}$$

where β_i^L is the lagged foreign exchange exposure, which measures the lagged effect of the exchange rate shock on the firm's stock return. He and Ng (1998) found that only 6 out of 171 Japanese multinationals exhibited significant lagged foreign exchange exposure, which is different to the results of the U.S. studies. This study employed this regression with the Chinese market to estimate the lagged effect of the exchange rate movements on the stock market.

4.3.2 The determinants of foreign exchange exposure

The second stage is to analyse the cross-sectional difference between foreign exchange exposure and firm specific characteristics. Based on the contemporaneous and lagged foreign exchange exposure, this study aims to locate the determinants of foreign exchange exposure. Jorion (1990) found that the foreign involvement is positively related to the foreign exchange exposure of U.S. multinationals. He and Ng (1998) found that the foreign exchange exposure increased with the firm size. Hutson and Laing (2014) examined the relationship between firm value and the firm characteristics, such as size, foreign sales, leverage, and liquidity. Following these studies, in the second stage and also following Jorion (1990), I am going to examine

whether the foreign exchange exposure is determined by firm specific factors. The regression is conducted with both the lagged and non-lagged models from earlier and is the following,

$$\hat{\beta}_{0i} = \theta_0 + \theta_1 EXP_i + \theta_2 SIZE_i + \theta_3 QR_i + \delta_i \quad (4.11)$$

$$\hat{\beta}_i^L = \rho_0 + \rho_1 EXP_i + \rho_2 SIZE_i + \rho_3 QR_i + \mu_i \quad (4.12)$$

Where the EXP_i refers to the export ratio, the percentage of the foreign sales revenue to the total sales revenue of the firm. Jorion (1990) used the export ratio to measure the degree of foreign involvement. $SIZE_i$ represents the firm scale and is measured by the total assets in this study. QR_i means the quick ratio, measuring the short-term liquidity of the individual firm. The higher the quick ratio the higher the ability of the firm to meet short-term debts with liquid assets. $\theta_i, i = 1,2,3$, is the estimated indicator of the relationship between the firms' specific factors and the contemporaneous foreign exchange exposure. $\rho_i, i = 1,2,3$, estimates the cross-sectional differences of different firm characteristics on the lagged exchange exposure. The standard errors are robust to autocorrelation and heteroscedasticity.

4.4 Data description and summary statistics

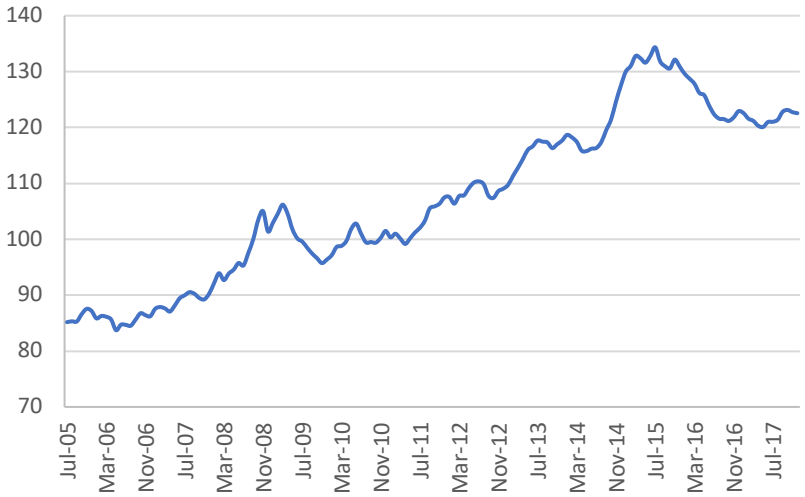
4.4.1 Exchange rate

The real effective exchange rate, derived from the International Financial Statistics (IFS) by the International Monetary Fund (IMF), is the weighted average of the domestic country's currency related to a basket of other major currencies that could have significant effects on the global economy. It is also adjusted by fluctuations in inflation. Choi and Prasad (1995), Gu, Zhang and Zheng (2013) employed the real effective exchange rate in their study while Allayannis and Ofek (2001) illustrated that the use of the nominal exchange rate makes little difference from the use of real effective exchange rates because the majority of the variance isn't derived from inflation but the exchange rate. Therefore, the Chinese real effective exchange rate index is used to measure the fluctuations of the exchange rate, which means that the real value of the RMB is increasing if the change of the real effective exchange rate is positive.

Table 4.1 Preliminary statistics of exchange rate and market return

	Real Effective Exchange Rates	Market Index
Observations	150	150
Minimum	83.732	1138.692
Maximum	134.353	6251.528
Mean	107.095	2870.337
Standard Deviation	14.571	925.450

Figure 4.1 The trend in the real effective exchange rate



(source: International Monetary Fund, International financial statistics)

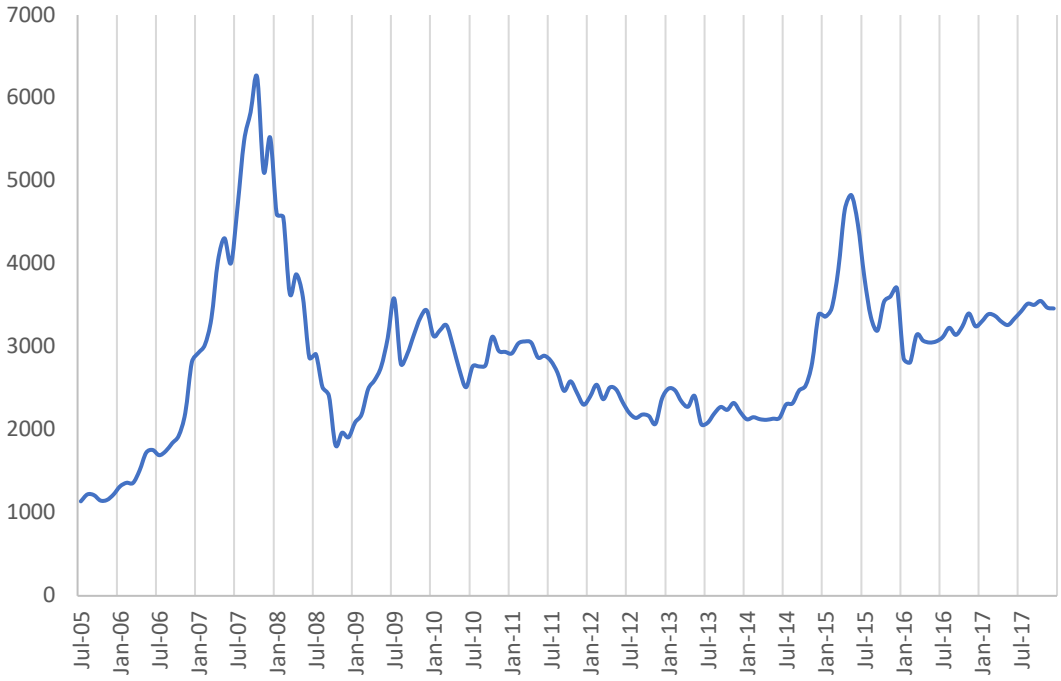
The sample period for this study starts from July 2005, the year when the government began the reformation of the exchange rate allowing it to be more flexible, and ends in December 2017, the year of the latest overseas business data for individual firms. From the graph, it can be seen that the RMB experienced a constant increase for the whole period, which means the RMB became more valuable in the global economy. However, the appreciation of the domestic currency increased the foreign exchange rate risk for exporting firms, since firms would lack

competitiveness in the foreign market as the real price of their export products increased. Luo and Jiang (2007) found that the majority of firms in the textile sector are negatively affected by the appreciation of the RMB while most firms in the metals and non-metallic industry benefited from the appreciation of the RMB. There are two sub-periods, from April 2009 to December 2009 and from August 2015 to the end of sample period, where the trend of the RMB exhibited a slight decrease. During the sample period, the RMB witnessed an appreciation phase and depreciation phase, which produced an asymmetric effect in the fluctuation of the exchange rate on the firm' value.

4.4.2 Stock return

Following Jorion (1990), Bartram (2004) and Gu, Wang and Ma (2016), this study used the rate of stock return to proxy the changes of the firm value. The rate of stock return, as measured by $R_{i,t}$, is computed by using the monthly stock prices of individual firms in the Shanghai stock exchange A shares from July 2005 to December 2017, as provided by the Wind database. The sample is chosen from around 1000 firms on the Shanghai stock exchange and the choice of firm has been based on whether the individual firm has overseas business and produces complete information about the firm specific factors during the sample period. This study is mainly focused on the firms with foreign operations, just as in Jorion (1990) and this study also excluded oil firms and the financial services sector. After eliminating firms with missing data, there are 127 firms left, which is the basic sample during estimation. To test for foreign exchange exposure, this study includes the market stock return index to control for the market influences. The market stock return is measured by R_{mt}, also collected from the Wind database and is the value-weighted market index of the Shanghai stock exchange. (See the Background chapter for details of the stock market and changes recently in regulations.)

Figure 4.2 The trend in market stock returns



(source: Wind database)

4.4.3 Foreign involvement

Jorion (1990) used the export ratio, which is the foreign sales to total sales, as the proxy for the degree of foreign involvement and he found that the foreign exchange exposure is positively related to the degree of foreign involvement of U.S. multinationals. Based on the Wind database, the revenue of the overseas businesses, which is similar to foreign sales, and total sales revenue of each firm are used to calculate the export ratio. The higher the export ratio, means the higher the degree of foreign involvement and the higher the exchange rate risk, which results in the higher foreign exchange exposure. Choi and Prasad (1995) analysed cross sectional differences of foreign exchange exposure and found that the scope of the foreign operations is positively related to the exchange rate risk sensitivity based on U.S multinationals. This study uses the export ratio to represent the foreign involvement of the total operations of the firm and tests the relationship between exchange rate exposure and the degree of foreign operations in the Chinese market. As seen from Table 4.2, the mean export ratio is around 25%, which means that on average there is one quarter of a firms' total sales revenue coming from overseas business.

4.4.4 Size

The firms which are a larger size are more likely to encounter a high foreign exchange exposure, since it would operate more businesses priced in the foreign currency, which can be influenced by the fluctuations of the value of the domestic currency. The size of the firm is an important factor for the foreign exchange exposure during cross-sectional analysis. The size effect was positively significant on the foreign exchange exposure when tested by He and Ng (1998). Zhao and Wang (2013) examined Chinese manufacturing firms and found that larger firms are more likely to be exposed to the movements of the exchange rate. In contrast, Dominguez and Tesar (2006) and Hutson and Stevenson (2010) illustrated that the small firms are more likely to have higher foreign exchange exposure because the firm with a larger size tends to use foreign currency derivatives to reduce exposure to the exchange rate, as proved by Hutson and Laing (2014). Therefore, as in the previous literature, this study uses the lorgarithmic form of total assets as the proxy for the size of the firm and tests whether the size is a determining factor of foreign exchange exposure. 3 out of 127 firms had missing data during the sample period and 124 firms were left for the second step.

Table 4.2 Summary statistics of factors that affect the foreign exchange exposure

	EXP	SIZE	QR
Mean	0.2498	22.3547	1.3032
Median	0.1760	22.2176	1.0096
Maximum	0.9242	25.6266	6.7926
Minimum	0.0069	20.0252	0.2746
Std. Dev.	0.2045	1.0648	1.1355
Skewness	1.1797	0.5610	2.7963
Kurtosis	3.7194	3.2020	11.3831
Jarque-Bera	31.4371	6.7142	524.6940
Probability	0.0000	0.0348	0.0000
Sum	30.9764	2771.9790	161.5974
Sum Sq. Dev.	5.1429	139.4532	158.5909
Observations	124	124	124

Notes: EXP refers to the ratio of overseas business revenue to the total sales; Size refers to the logatithm form of total assets and QR is the quick ratio of firms.

4.4.5 Liquidity

Liquidity indicates the ability of the firm to meet short term debt with short term assets and the firms could efficiently control for liquidity risk with higher liquidity. Froot et al. (1993) illustrated that liquidity is related to hedging activities. Hedging theories indicate that a higher quick ratio results in a higher exchange rate exposure, since the firm with a higher quick ratio is less likely to use hedging instruments to reduce risk. However, the previous studies showed mixed results. He and Ng (1998) found that the quick ratio is positively related to the foreign exchange exposure of Japanese multinationals, while Muller and Verschoor(2006), and Hutson and O'Dcriscoll (2010) presented different results finding that the quick ratio is negatively but insignificantly related to the foreign exchange exposure of European firms. Akay and Cifter (2014) examined firms in Turkey and found that the coefficient of the quick ratio to foreign exchange exposure is negative and significant in textiles. This study uses the quick ratio, which is available for all 124 firms, to represent the short-term liquidity, as in He and Ng (1998), to determine whether the liquidity of the firm could influence the foreign exchange exposure. From Table 4.2, the average of the quick ratios is around 1.3 and the median is 1.00, which indicates that most of the firms experience a quick ratio of less than 1 as the distribution of the quick ratios is positively skewed. As a result, the majority of firms exhibit an unhealthy financial situation and are struggling with repayments of their current liabilities.

4.5 Empirical results

4.5.1 The foreign exchange exposure

(1) Contemporaneous exposure

The first stage is to examine the effect of exchange rate changes on the value of the firms. This study employs Jorion (1990)'s two-factor model to regress the common stock return of the Shanghai stock market A shares on the market return and Chinese real effective exchange rate. As Allayannis and Ofek (2001) have demonstrated, there is little diffence in using real effective exchange rates, nominal effective exchange rates and bilateral exchanges rates, this study applies the real effective exchange rate into the model. Also, as listed firms are involved in global business with various countries, they are exposed to different currencies exposure, so the real effective exchange rate, represented by the domestic currency against a basket of currencies, is a more comprehensive measure than the bilateral exchange rates. If the coefficient of the real effective exchange rate is positive, the appreciation of the RMB is positively related to the value of the firm. Otherwise, if the coefficient of the real effective

exchange rate is negative, the firms' value is negatively related. The full sample period is from 2005:07 to 2017:12, the last year for which all data is available as in Jorion (1990) we divide the data into two sub-samples. As explained in the background chapter, this study has used the end of 2011 as the separation point to split the sample period into two sub-periods, from 2005:07 to 2011:12 and from 2012:01 to 2017:12, due to the government relaxing the ban on short selling and margin trading on the stock market, which made it more flexible and made the stock market more efficient. The stock market could more effectively reflect the effects of the exchange rate shocks than before, so we would expect the relationship to hold better after 2012. Following the study of Jorion (1990), the results are shown in the Table 4.3.

Table 4.3 Estimation of model (4.9)

contemporaneous exposure(β_{0i})			
	2005.07-2017.12	2005.07-2011.12	2012.01-2017.12
Min	-2.7580	-4.0196	-3.436
Median	-0.3099	-0.4505	-0.4560
Max	2.0772	3.4243	2.1122
Cross-sectional mean	-0.2702	-0.3933	-0.4418
Cross-sectional SD	0.8288	1.1126	1.2812
the No. of significant	10	10	11
the percentage significant firs of total firms	7.87%	7.87%	8.66%
No. of positive	41	43	47
No. of negative	86	84	80
Stability, No. of firms with same sign for exposure		71	

For the whole period, 7.87% of the total 127 firms exhibit significant contemporaneous exposure. Jorion (1990) found only 5% of total firms' stock returns are significantly related to the fluctuations of the dollar in the U.S. market. The mean exposure of all sample firms is around -0.27, which means the value of firms are negatively related to the Chinese real effective exchange rate. The coefficients for exposure of 86 firms are negative, while the number of firms with a positive sign of exposure are 41. The number of firms with negative signs for the full sample period is almost twice the number of firms with positive signs. The results of two

sub-periods are similar to the full sample period. It can be explained as the manufacturing industry has the most important role in the Chinese market and most manufacturing firms are exporters. For export firms, the value of the RMB is negatively related to the value of the firm. As the value of RMB increase, the real price of the export products increases, which leads to less competitiveness of the firm in the foreign market. As a result, the market demand for products would decrease, and the profits of the firms decrease. Therefore, the common stock returns of the export firms are negatively affected by the appreciation of the RMB. On the other hand, export firms could benefit from the depreciation of the RMB.

There are 10 out of the 127 firms showing a significant foreign exchange exposure in the first sub-period from 2005:07 to 2011:12. The average level of the foreign exchange exposure is about -0.39, which is lower than the cross-sectional mean of the firms for the sample period. The 43 firms exhibit a positive exchange rate exposure, which is less than the number of firms experiencing negative effects from the appreciation of RMB. It might be explained as before by the fact that most of firms in China are manufacturing firms, such as textiles, who tends to export their goods. The exporters experience negative effects from the appreciation of currency. Gu, Wang and Ma (2016) achieved the same results that more firms witnessed negative exchange rate exposure. During the first period. Compared with the results in the second period, the number of firms with a negative exposure is less than in the first period, while the number of firms with a positive exposure is higher. The percentage of firms with significant exposure increases from the first period to the second period. After the relaxation of the limitations on the stock market, the stock market becomes more flexible and efficiently reflects the effect of the changes in the value of the RMB. Meanwhile, 71 out of 127 firms show stability in the sign of the foreign exchange exposure, which means that the exchange rate changes have the same directional effect on stock returns of those firms.

(2) Lagged exposure

Amihud (1994) found that there is little significance of the effect of contemporaneous exchange rates on the firm's value in the U.S. market. So this study explores whether there exists a lagged effect of exchange rates in the Chinese stock market. The results of estimating the lagged exchange rate exposure are in the following table.

Table 4.4 Estimation of model (4.10)

Estimation for lagged exposure (β_i^L)			
	2005.07-2017.12	2005.07-2011.12	2012.01-2017.12
Min	-2.4612	-3.3727	-4.7814
Median	-0.0600	-0.0024	-0.2106
Max	2.5964	2.0555	4.1904
Cross-sectional mean	0.0027	-0.0371	-2.7775
Cross-sectional SD	0.8288	1.0965	1.7056
the No. of significant	8	3	9
the percentage of significant firms out of the total firms	6.30%	2.36%	7.16%
No. of positive	63	63	56
No. of negative	64	64	71
Stability, No. of firms with same sign for exposure		68	

Notes: The results for β_{0i} is summarized at the table A.1 in the appendix. The significance level is 5%.

Similar to He and Ng (1998) who found in Japan, there is little significant effect of the lags of exchange rates for the full sample period and sub-periods, especially in the firs sub-period. The stock markets in China with severe interventions on foreign trades are not flexible enough to reflect the fluctuations of the exchange rate. Also, due to the management of the floating exchange rate, the government helps firms and banks to mitigate the shock from exchange rate changes. 68 of the 127 firms kept the same sign for foreign exchange exposure for the two sub-periods, which means that the foreign exchange exposure could be determined by the firms' specific characteristics, such as the level of foreign trade, size and the industry characteristics. The following section is the results of the examination of the factors determining foreign exchange exposure.

4.5.2 The determinants of exposure

After the first step of estimating the contemporaneous and lagged exchange rate exposure, the second stage aims to analyse the cross-sectional difference using the whole sample period and two sub-periods. Firms with specific characteristics witness different types of effect from the

fluctuations of the exchange rates as they use different hedging strategies to control their exposure to foreign exchange rate. Smith and Stulz (1985) illustrated that the hedging activities could affect the magnitude of foreign exchange exposure. Therefore, the second stage of this study is to test the relationship between the exposure of Chinese firms on the Shanghai stock market A shares to the exchange rate movements and the firm specific characteristics. The expected results are that firms with more foreign business would witness larger exposure in the foreign exchange market, since the fluctuations of the exchange rate could cause large losses or profits in its overseas business. The contemporaneous foreign exchange exposure coefficient, estimated in the first step are regressed on the foreign operations, size and liquidity of firms in this stage. The empirical results are shown in the table.

Table 4.5 Estimation of model (4.11)

The Determinants of Contemporaneous Foreign Exchange Exposure			
Variables	2005:07-2017:12	2005:07-2011:12	2012:01-2017:12
_cons	-2.431	-2.770	-2.576
	(-1.38)	(-1.37)	(-0.99)
EXP	0.089	-0.640	1.35**
	(0.30)	(-1.49)	(2.58)
SIZE	0.099	0.115	0.088
	(1.29)	(1.33)	(0.79)
QR	-0.062	-0.390	-0.152*
	(-0.96)	(-0.46)	(-1.76)
Observations	124	124	124

Note: The t-statistics is in the parentheses. *, **, *** represent 10%, 5% and 1% significance level respectively.

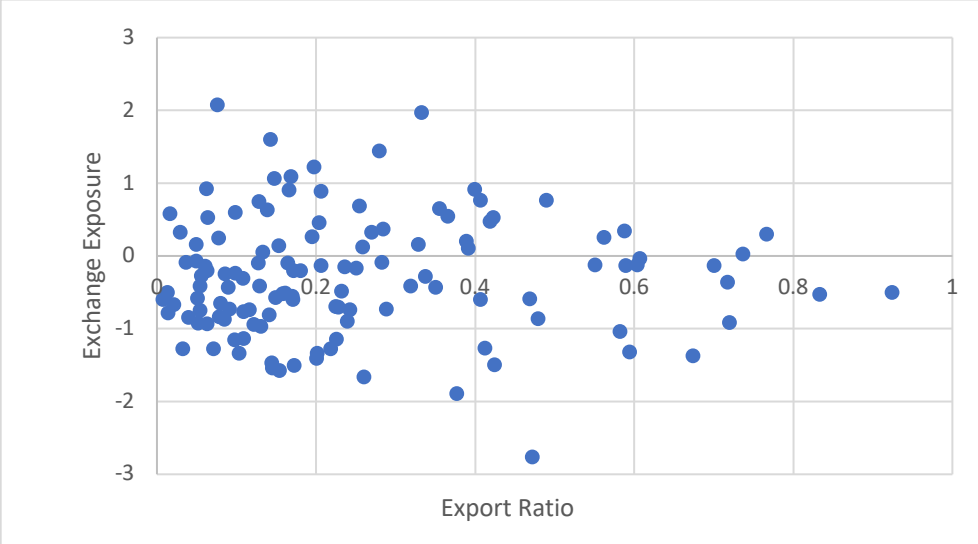
Table 4.6 Estimation of model (4.12)

The Determinants of the Lagged Foreign Exchange Exposure			
Variables	2005:07-2017:12	2005:07-2011:12	2012:01-2017:12
_cons	3.452	5.217	-1.776
	(1.76)	(2.15)	(0.50)
EXP	-0.077	-0.111	-0.344
	(-0.19)	(-0.26)	(-0.45)
SIZE	-0.153*	-0.231**	0.074
	(-1.80)	(-2.14)	(0.50)
QR	0.014	-0.115	0.010
	(0.17)	(0.89)	(0.05)
Observations	124	124	124

Note: The t-statistics is in the parentheses. *, **, *** represent 10%, 5% and 1% significance level respectively.

The following scatter plot describes the general relationship between the export ratio and exchange rate exposure. It seems that when the export ratio increases, the absolute value of the exchange rate exposure increases, which means that the firms have larger exchange rate exposure if they have more foreign operations.

Figure 4.3 The relationship between exchange rate exposure and the export ratio



Note: The foreign exchange exposure is estimated from equation 4.9 and the export ratio represents the level of trade, which is the ratio of foreign sales to total sales.

The export ratio is computed as in Jorion (1990), which is the ratio of foreign sales to total sales. The higher export ratio refers to the higher degree of foreign involvement of the firm. For the full sample period, the level of foreign involvement is positive but not significant to the foreign exchange exposure of firms. However, Jorion (1990) found that the foreign exchange exposure increased with the increasing degree of foreign operations in U.S. multinationals. It can be seen from the table 4.5 that the coefficient on the export ratio is not significant in the first sub-period, from 2005:07 to 2011:11, but significant at the 5% significance level from 2012:01 to 2017:12. In the first sub-period, the coefficient of the export ratio is negative, which could be accounted for by the intervention of the government in foreign trade so the firms cannot choose the variety of foreign trades, which reduces the possibility of meeting more foreign exchange rate risks. The export ratio is significant and positively related to the foreign exchange exposure from 2012, which means that in the first sub-period, the level of foreign sales does not significantly affect the contemporaneous foreign exchange exposure of firms. The possible explanation for this result is that the stock market became more flexible

and efficient from the end of 2011 when the government relaxed the ban on short-selling and margin trading in the Shanghai stock market. As a result, from 2012, the exposure of firms could effectively reflect the effect of exchange rate fluctuations. Firms, which are highly international, are more easily affected by the fluctuations of the value of the RMB. If the real effective exchange rate increases, referring to the appreciation of RMB, the real price of overseas products are raised and the demand in the market declines, which results in the loss of overseas revenue for firms. Therefore, firms with higher export ratios witness the higher foreign exchange exposure, just as Jorion (1990) found for the U.S market.

Firm size, proxied by total assets, is in theory an important factor for each firm and this stage estimates the relationship between size and foreign exchange exposure of firms. The coefficients of size are not significant to the foreign exchange exposure but they are positive to the foreign exchange exposure for both sub-periods and the full sample period. The relationship for firms regarding size is 0.115 and 0.088 for the two sub-periods respectively. The larger the size of the firm, the higher exposure the firm meets. He and Ng (1998) found there is a positive relationship between Japanese firms 'size and the extent of exposure to the exchange rate movements. However, Hutson and Elaing (2014) examined U.S. multinational corporations and found that the size of firms is inversely related to the foreign exchange exposure, which means small firms are easily exposed to the exchange rate changes in a higher level.

The different results between the U.S. and China may be explained by the different degree of development of the foreign exchange markets. Floating exchange rate regimes have been used in the U.S. for many years, while the floating exchange rate regime has been used since 2005 in China and heavily controlled by the central bank and the government. Also, the government set some limitations for the use of some foreign currency products or derivatives, which results in the lack of hedging instruments firms could use. The larger firms tend to have more foreign operations, so they are more easily exposed to the changes of value of RMB. In contrast, the developed foreign exchange market in U.S. allows firms to use foreign currency derivatives without severe limitations and the firms with a larger size tend to use foreign currency derivatives to hedge their foreign exchange exposure and mitigate the negative effect caused by exchange rates. Therefore, it is reasonable that firm's size is positively but insignificantly related to the foreign exchange exposure in China due to the lack of flexibility of the use of hedging products in the foreign exchange market.

The liquidity of each firm is measured by the quick ratio, collected from the Wind database. From the table 4.5 which summarizes the results from estimating equation 4.11, it can be seen that the liquidity is negative and does not have a significant effect on foreign exchange exposure in the first sub-period but it has a significantly negative effect in the second time period but only at the 10% significance level. Although some literature found that the quick ratio of firms is positive and significantly related to the foreign exchange exposure, such as He and Ng (1998) in Japan, this study suggests it follows a similar pattern to US firms rather than Japanese ones. As stock markets in China relaxed the ban on short-selling, the liquidiy and flexibility of the markets have been developed as the way in the US market. The financial markets can well reflect the market demand and supply after liberalisation. The quick ratio represents the short-term liquidity risks of the firm so firms with higher quick ratio have higher ability to repay their short-term debt, results in less risk exposure. The table 4.6 contains results from examining the determinants of the lagged foreign exchange exposure. It shows that there is a negative effect on the lagged foreign exchange exposure, which can be explained by the way that firms which are exposed to less risk exposure are more likely to pursue more investments to increase their firm size.

Finally, I separate the foreign exchange exposure into two groups based on their sign on the exchange rate exposure. The results are shown in the following table,

Table 4.7 Splitting firms with the sign of exposure

Estimation of determinants of positive exposure and negative exposure						
	2005.07-2017.12		2005.07-2011.12		2012.01-2017.12	
	Positive	Negative	Positive	Negative	Positive	Negative
_cons	0.872	-1.249	2.329	-2.978	1.808	-4.639
	(0.47)	(-1.10)	(1.36)	(-1.92)	(0.82)	(-2.1)
EXP	-0.522	-0.043	-0.546	-0.592	-0.25	0.414
	(-1.34)	(-0.17)	(-1.2)	(-1.66)	(-0.66)	(0.75)
SIZE	0.003	0.03	-0.056	0.099	-0.044	0.142
	(0.04)	(0.61)	(-0.79)	(1.51)	(-0.47)	(1.47)
QR	-0.116**	-0.107*	-0.105*	-0.087	0.178	0.097
	(-3.24)	(-2.62)	(-1.77)	(-1.30)	(0.70)	(1.07)

Note: The t-statistics is in the parentheses. *, **, *** represent 10%, 5% and 1% significance level respectively.

It seems that there is little significance between foreign exchange exposure and firms' specific factors with negative exposure and positive exposure, so there is no evidence of any asymmetry in this relationship. It shows no significance in the level of foreign operations to the foreign exchange exposure for firms with either positive exposure or negative exposure.

4.6 Conclusion

Unlike the results found by Jorion (1990) that the level of foreign involvement is significantly and positively related to the exchange rate exposure of U.S. multinationals in two sub-periods and the full sample period. This study only finds a significant and positive relationship between the exchange rate exposure and the level of foreign trade from post-2012 to 2017 but it is not significant from July 2005 to December 2011. These results are due to the liberalization of Chinese stock markets because the government relaxed the ban on short selling and margin trading in 2011 for A-shares and extended this relaxation to more securities on the SSE in December 2011. This allows the stock market to become more flexible and efficient, which moves it closer to the characteristics of the U.S. stock markets. Therefore, I get similar results post-2012 to those of Jorion (1990) for U.S. firms. Firms with lower short-term liquidiy risks experience less foreign exchange exposure. Also, this empirical study contributes to literature by exploring the foreign exchange exposure in all industries in China and accounting for the

liberalisation of financial markets for the first time. However, the study follows a traditional way to estimate foreign exchange exposure with a two-factor model. Further studies could consider the market capitalization and firms value premium, which might affect the firms ability of risk control, when estimating the foreign exchange exposure faced by firms.

Chapter 5

The Determinants Of Foreign Currency Derivative Usage

5.1 Introduction

As the economic environment has become more and more globally connected, firms are now more likely to be exposed to a variety of risks and they need to manage the exposures with appropriate risk management strategies. The firms face a more competitive market than before as competition has increased from all over the world. A global shock to supply and demand would lead to firms being exposed to an uncertain environment and experience increased volatility in their earnings. As the exchange rate changes, the price of goods and the cost of imports are affected, which in turn influences the profitability and earnings of the firms that trade in foreign markets. Not only do the firms with foreign trade face risks but also domestic firms are exposed to more intensive competition. Thus, the risk aversion of managers would motivate firms to hedge using foreign currency derivatives, because hedging could minimize risk exposure and so increase the firm's value by smoothing the volatility of cash flows, reducing the volatility of stock returns and mitigating against the costs of financial distress and agency.

Thus, it is important to examine what determines the use of derivatives and so identify how the firm value is affected in an imperfect market. Mian (1996) and Ameer (2010) developed empirical studies focusing on the determinants of corporate hedging and found that firm specific characteristics do affect decisions on the use of derivatives, such as size, growth opportunities and profitability. Internal and external governance and managerial ownership can influence hedging strategies due to the existence of agency costs and conflicts of interest between shareholders and managers, as shown by Doidge, Karolyi and Stulz (2007) and Fauver and Naranjo (2010). As the Chinese economy has developed rapidly, increasingly firms have expanded their business abroad, thus they may experience foreign exchange exposure due to exchange rate movements. As a result a number of firms would like to use foreign currency derivatives to reduce risk exposure. The previous literature has been more focused on using cross-sectional analysis with a fixed effects static model to analyse factors that influence derivative usage, but it would be more informative to use a random effects probability model to analyse the relationship between past and current behaviour. The main econometric problem in employing the dynamic probit model is unobserved heterogeneity and the initial parameter

value. Heckman (1987) and Woolridge (2005) proposed different approaches to solving the initial conditions problem and Stewart (2006) explored a convenient way to apply the Heckman estimator and allowed for endogenous variables Shao et al. (2019) estimated hedging with commodity futures for non-financial firms in China and as the complete disclosure of using derivatives becomes available in China, it is possible to study the trends of other derivative usage, such as the foreign currency derivatives and interest-rate derivatives. Thus, in this chapter I provide empirical evidence of China's use of derivatives and its dynamic application of risk management strategies.

Specifically, during the first stage, this chapter intends to use a static model to identify the determinants of the use of foreign currency derivatives, including foreign currency forward contracts, futures and swaps, based on a sample of Chinese firms with foreign businesses. The second stage is to find out the dynamics of using foreign currency derivatives whilst controlling for the asymmetric information and agency problems and compare different estimators when using the random effects probit model. This chapter contributes to the previous literature by exploring the evidence on a specific market, which is historically not as efficient as the U.S. market. This is achieved by adding the degree of foreign sales for a firm as an important determinant of the use of foreign currency derivatives. We only focus on the firms in manufacturing industries, which enables me to control for industry specific characteristics. Moreover, this chapter takes market information asymmetry and agency problems into consideration to provide evidence that could improve the regulation of the over-the-counter derivatives market.

This chapter has six sections while the first section is the introduction, the second section reviews theoretical and empirical literature related to derivatives usage and the development of the dynamic probability model. The third section explains the methodology and proposes hypotheses and the fourth section provides data sources and explains the model. The fifth section summarizes and analyses the results and in the last section I offer some conclusions and policy implications.

5.2 Literature review

5.2.1 Determinants of hedging

The theoretical literature mainly focuses on constructing theoretical models so as to estimate risk exposure and the effects of hedging strategies, which emphasizes the importance of risk management to firms. MM theory illustrates that the capital structure of a firm is irrelevant to the firm's value when the market is complete with perfectly transparent information. In reality, the existence of taxes and the transaction costs of bankruptcy provide incentives for firms to do risk management, as suggested by Mayers and Smith (1982). Furthermore, a theory by Smith and Stulz (1985) provides a value maximising function to explain how hedging behaviour affects the wealth of shareholders through different channels which include taxes, the transaction costs of bankruptcy and the costs of financial distress and managerial compensation, which is the fundamental theoretical literature underlying the empirical studies. Based on a convex tax function, Leland (1998) provided a quantitative model, which estimated the dynamic effects of hedging strategies on the capital structure of firms and finds that hedging strategies bring significant benefits especially to the firms with lower agency costs.

The risk management theories relating to hedging are supported by many of the empirical studies. The results of Nance, Smith Jr and Smithson (1993) showed that 61.5% of 169 firms used derivatives to hedge in 1986. Guay and Kothari (2003) quantified the risk reduction of the largest firms by using derivatives to hedge and concluded that firms only consider derivatives as a small proportion of their whole portfolio, which doesn't support the previous risk management theories regarding derivatives as one of the most important hedging tools. However, there is plenty of evidence from firms in the United States which have proved the consistency of hedging behaviour with the theory of the optimal risk management strategy, given by Howton and Perfect (1998), Allayannis and Ofek (2001), Graham, J.R. and Rogers (2002). Their findings provide similar implications on the use of currency derivatives reducing the exposure of U.S. firms. Besides there is also evidence from U.S data, such as international evidence by Bartram, Brown and Fehle (2009), which used a substantial dataset from firms in multiple countries, indicating 7,319 firms hedge different types of risk by using foreign exchange derivatives, interest rate derivatives and commodity price derivatives and that approximately 64.9% of 2,231 firms in the United States use derivatives to mitigate against risk exposure.

Foreign exchange derivatives are more commonly used by firms than interest rate derivatives and commodity price derivatives. Unlike other studies using U.S. data, Judge (2004) explored the determinants of hedging based on UK non-financial firms. Allayannis, Lel and Miller (2012) used data from a total of 1,546 non-U.S. firms with foreign sales from 39 countries between 1990 and 1999 and their results showed 61% of total firms use foreign currency derivatives to hedge and are more profitable than firms that don't use derivatives. Focusing on firms in the AIM market (Alternative Investment Market), Marshall, Kemmitt and Pinto (2013) find 33% of firms hedge their foreign exchange exposure, which is a lower value than the previous literature based on the whole financial market.

As exchange rate movements have become more important to Chinese corporations in recent years, Aggarwal, Chen and Yur-Austin (2011) have estimated the currency exposure arising from the different trading partners of China and Ye and Hutson (2011) examine how Chinese bank's manage foreign exchange exposure. However, there is less literature paying attention to studying the effective results of hedging behaviour in reducing risk exposure and the determinants of derivatives usage.

Although it is difficult to explain the intuition behind the use of derivatives, empirical studies have sought evidence and used various techniques to determine the purpose of derivative usage by firms, which might be for hedging or speculation, as suggested by Géczy, Minton and Schrand (2007) and Guay (1999). Adam and Fernando (2006) indicated doubts in the benefits of derivative usage for cash flow purposes by using a sample of gold mining firms. Aretz and Bartram (2010) presented an overview of the theoretical literature related to risk management strategies which has little ability to explain why firms hedge, since it is difficult to find any real motivation behind the use of derivatives, which are considered as one of the most important risk management tools. The exchange exposure puzzle is a theory put forward by Dominguez and Tesar (2001) and Bartram, Brown and Minton (2009), suggesting that there is no statistically significant foreign exchange exposure for firms, which could be explained by the efficiency of foreign currency derivatives usage. Moreover, Brown, Crabb, and Haushalter (2006) indicate 84% and 76% of U.S. nonfinancial firms use derivatives to alleviate the impact of exchange rate changes and interest movements on firms respectively.

Besides lowering the risk exposure by hedging with derivatives, another part of the literature has focused on exploring the factors which could determine the use of foreign currency

derivatives. The decision on whether to use derivatives and the underlying assets of these derivatives, such as for interest rates and exchange rates, are influenced by the types of risks that the firm wants to mitigate, as noted by Géczy, Minton and Schrand (1997) and Hagelin (2003).

Nance, Smith Jr and Smithson (1993) reported that firms with more tax convex functions are more likely to use derivatives to hedge. Graham and Smith (1999) consider tax as one of the motivations to hedge with derivatives as it reduces the tax liability by smoothing the volatility of taxable income due to the convexity of the tax function. There were two tax incentives examined by Graham and Rogers (2002) who tested the effect of tax incentives on hedging decisions, which they found was influenced by firm size and the expected costs of financial distress at the same time. Campello et al. (2011) employed a tax-based instrumental method to identify the channels which allow firms to hedge more.

Based on the fundamental theory developed by Smith and Stulz (1985), hedging to mitigate against risk exposure is associated with the costs of financial distress, which implies effective risk management could lower the probability of encountering financial difficulties for the firm. Judge (2004) suggested that the costs of financial distress would motivate firms to hedge. With an extension to the early theoretical literature, Purnanandam (2008) proposed a new model on hedging by including financial distress costs and it found the previous predictions on financial distress costs were one of the main incentives for hedging and especially in industries with high levels of concentration.

Although many empirical studies have shown that financial distress and managerial incentives are significant determinants of hedging, the results from Bartram, Brown and Fehle (2009) implied financial distress is statistically significantly important for larger firms but manager incentives are more significant for smaller firms. In comparison to country-level factors, firms attach more importance to firm-level characteristics when they consider whether to hedge with derivatives.

The mixed results on the relationship between the use of derivates and financial distress costs remains controversial, although the different results could be explained by the use of different proxy variables, such as in Aretz and Bartram (2010) who compared differences in the results when using the long-term debt ratio and interest coverage ratio. In addition agency problems

exist between shareholders and managers resulting from the conflicts of interest, thus both managerial ownership and managerial compensation play important roles in hedging when the manager is monitoring the portfolio, as found by Smith and Stulz (1985) and Bisin, Gottardi and Rampini (2008).

Smith and Stulz (1985) and Chen, Steiner and Whyte (1998) illustrate that risk aversion motivates managers to use derivatives to smooth the volatility of cash flows or stock returns, which is linked to the managers remuneration. Gay and Nam (1998) considered the underinvestment problem as one of the determinants of hedging and suggested that hedging helps to avoid the underinvestment problems due to the positive relationship between derivative usage and a firms' growth opportunities.

Some previous studies have found that managerial ownership is positively associated with the use of foreign exchange derivatives, Adkins, Carter and Simpson (2007) who examined 252 large banks, using some form of managerial compensation, such as option awards, had a negative relationship with derivatives usage. This negative relationship supports the theory of Smith and Stulz (1985) where the benefits from hedging are offset by the cost of compensation made by shareholders. Marshall, Kemmitt and Pinto (2013) have identifed managerial ownership of firms listed on the Alternative Investment Market (AIM) as a determinant of foreign exchange hedging and the concentration of the ownership is negatively related to the use of hedging. Furthermore, within firms on the AIM market, the larger firms hedge more than the smaller firms due to the lack of expertise on how to mitigate the impact of exchange rate movements, which is consistent with Judge (2004). Géczy, Minton and Schrand (1997) and Graham and Rogers (2002) presented evidence on the institutional ownership incentive for foreign currency derivative usage by U.S. firms.

A firms' hedging decision is a vital part of the firm's governance, including internal corporate governance and the external governance of the country where the firm operates. Allayannis, Lel and Miller (2003) and Allayannis, Lel and Miller (2012) have concluded that the role of corporate governance is important when firms make decisions on the use of foreign currency derivatives. Empirical evidence across 30 countries, by Lel (2012), showed that firms with strong governance preferred to use foreign currency derivatives to hedge their exchange risk exposure while the reasons for firms with weak governance using derivatives is different.

In addition to firm-level characteristics, market opinions and expectations are also important reasons for the use of derivatives. Brown, Crabb, and Haushalter (2006) examined the impact of market views on the hedging decision making process, such a state is considered as selective hedging as defined by Stulz (1996) and explains why it is widely used by managers to incorporate market views into hedging policies. Moreover, Bartram, Brown and Fehle (2009) explored the determinants of derivative usage at the country level and their results showed that the size and efficiency of derivatives markets influenced the firms' decision to use foreign currency derivatives. Reviewing the evidence from 175 previous studies on various endogenous and exogenous variables regarded as determinants of derivative usage, such as dividend payout ratios, debt ratios, and interest coverage ratios, Geyer-Klingeberg, Hang and Rathgeber (2019) indicated that firms do not attach equal importance to all the factors affecting a firms' decision to use derivatives.

5.2.2 The methodology to analyse hedging behaviour

Logit or Probit regression analysis is commonly used in empirical studies into the use of derivatives, where a binary variable proxies the hedging decisions of firms. Nance, Smith Jr and Smithson (1993) employed the logit regression analysis with a binary variable to proxy the use of hedging and used the restricted specification to increase the power of the tests. Much of the literature has focused on empirical studies that choose the fixed effects logit model while fewer studies have employed the probit regression considering individual effects as random effects. To study the static probability model, Chamberlain (1980) employed different approaches on random effects and fixed effects and proposed that the marginal likelihood estimation would result in a new estimator in the probability model. Manski (1985) firstly introduced the maximum score estimation which provides consistent estimators for linear random effects binary models and then Manski (1987) improved the maximum score estimation with further conditions to the extended model. Arellano (2003) focused on econometric issues of static discrete choice models particularly in the cases where unobserved variables are correlated with explanatory variables and examined the efficiency of a fixed T approach to solve the problem. Meanwhile, Arellano and Bonhomme (2009) illustrated that the standard method for estimating random effects does not give consistent estimators for a large T dataset but they added conditions to the model to reduce the bias.

Although Heckman (1987) has used the maximum likelihood estimation for discrete panel data to solve the initial conditions problem and this estimator is popular and attractive to scholars due to the relaxation of the need for stationarity based on the fixed effects model, the model did not perform well when the endogeneity problem exists. To solve the initial parameter problem, Heckman (1987) proposed a reduced form for the initial value and Wooldridge (2005) employed conditional maximum likelihood estimation (CML), which means the distribution of individual effects is conditioned on the initial value, in non-linear dynamic models which included lagged variables in the equation. Stewart (2006) proposed a stata program for the Heckman estimator and this program mitigates the endogeneity effects of the initial conditions compared with standard random effects probit models which has the strict assumption of exogeneity. Stewart (2007) mentioned that unobserved heterogeneity and initial condition problems are the two main econometric difficulties in dynamic panel models. He employed a dynamic random effects probit model for examining the relationship between unemployment and low-wage jobs and made comparisons between random effects probit estimators, including the Heckman estimator and Woolridge approach, and GMM estimators regarding linear discrete panel models. Arulampalam and Stewart (2009) provided comparisons of estimators from the approaches of Heckman, Orme and Wooldridge by using Monte Carlo simulation experiments and the results indicated that the three estimators show no differences in the majority of cases and Arulampalam and Stewart (2009) proposed an alternative way to use the Heckman's estimator which is more convenient for linear and non-linear dynamic probit models. Gao, Bergsma and Yao (2017) have provided the solution to the problem of the Heckman's estimator and developed a new and consistent estimator for static and dynamic panel probit models in terms of large individual effects and short time periods.

Random effects probit models have been widely applied into different dimensional economic research, such as macroeconomics and behavioural economics. The improvement in the dynamic probability model is especially vital for promoting research in corporate finance. For example, the random effects probit model including state dependence was employed by Benito and Young (2003) to find the determinants of dividend behaviour of firms and the effect of tax system changes on dividend behaviour. Bernard and Jensen (2004) employed the probit model to find factors that influence the decision of U.S. manufacturing firms to expand into export markets while Requena-Silvente (2005) studied the determinants of entering foreign markets for UK firms by using the probability model.

It can be seen from the past literature that the random effects probit model is non-trivial in terms of studying microeconomics, especially in analysing the behaviour of firms in participating in certain economic activities but it seems that the improved random effect probit model has largely been ignored by empirical studies on corporate behaviour. Adkins, Carter and Simpson (2007) used the probit model to estimate the relationship between institutional ownership and the use of derivatives. Survey evidence reported by Graham and Harvey (2001) showed that the risks of the firm play a more important role than risk of the project itself when managers access new investments. Graham and Rogers (2002) investigated how the use of derivatives affected the leverage of the corporation using a simultaneous equations model. A dynamic analysis of the relationship between financial distress and risk management is reported by Purnanandam (2008) illustrating a non-monotonic relationship between leverage and derivative usage. More recently an alternative method has been used to estimate the determinants of hedging and the motivation behind the use of foreign currency derivatives. Arnold, Rathgeber and Stöckl (2014) and Geyer-Klingeberg, Hang and Rathgeber (2019) applied a meta-regression analysis, which is a regression analysis of previous regression analyses to review previous studies and identify the heterogeneity in previous empirical evidence, concerning the multidimensional characteristics of firms and financial market environment.

5.3 Hypotheses and methodology

5.3.1 The determinants of the use of foreign currency derivatives

The Logit and probit models are popular for studying factors which affect the decision on whether to use derivatives since the studies employ a binary variable assigning values of 0 or 1 for the use of derivatives. Including control variables, Bartram, Brown and Fehle (2009) used the probit estimation of derivative decision making, including three classic types of derivative instruments, to find out which country specific factors and firm factors affect the decision. Allayannis and Ofek (2001) not only included the simple binomial probit model but also focused on the firms using derivatives in the second phase, which is called the two-stage least square model first proposed by Cragg (1971). Nance, Smith Jr and Smithson (1993) tried to increase the explanatory power of the model by using the logit model and Fauver and Naranjo (2010) employed a logit regression to detect the impact of agency and monitoring problems on the use of derivatives and used restricted specifications to compare the results. However, other studies employed generalised least squares with a continuous variable as the dependent variable, such as Berkman and Bradbury (1996) and Guay and Kothari (2003). They collected the

notional amount for the derivatives contracts to estimate how much of the derivatives usage was affected by the firms' characteristics, which could have provided more information than using a binary variable approach. The first phase of this paper is to find out the factors that determine the use of derivatives, during the current period which could influence the manager's behaviour to hedge with a static probit model. Thus, following the hedging theory proposed by Smith and Stulz (1985) I consider the financial distress and agency costs as determinants of the use of foreign currency derivatives in my model. As a higher probability of bankruptcy indicates more volatile cash flows in the future, the use of currency derivatives are expected to mitigate risks and to smooth earnings. Moreover, as a result of decreasing risk exposure by using derivatives, firms could experience a reduction in agency costs. In addition, I will follow Fauver and Naranjo (2010)'s method to examine the effects of information asymmetry which could affect the use of foreign currency derivatives as the Chinese financial makets are heavily controlled and are not as transparent as other developed countries. Following the majority of studies, such as Allayannis and Weston (2001) and Fauver and Naranjo (2010), I employ a method to measure the use of foreign currency derivatives through a binary variable approach, which means the dependent variable equals 1 when the firms use the foreign currency derivatives and equals 0 otherwise but this paper only focuses on one type of derivative. I hand collected the derivatives data from the annual reports of the manufacturing firms on Shenzhen Stock exchange. As the requirements for discolure ofthe use of derivatives were introducedfrom 2012, I collected the derivatives data from 2012 to 2017 by searching key words from the annual reports, such as foreigen exchange risks, derivatives, forward contracts and futures. As accounting disclosure becomes more integrated in the future, more comprehensive data could become available and convenient for researchers to collect. The basic static model used in the first part is a standard random effects probit model, which follows Heckman's (1987) method to solve the initial conditions problem. A binary variable has been used due to the unavailability of consistent derivatives data disclosed in China. However, it is important to analyse derivatives usage in China, which has recently attracted the governments' attention in order to strengthen the regulations on the disclosure of derivative use.

The Theoretical literature such as Smith and Stulz (1985) predicted that the use of derivatives is determined by taxes with the assumption of the convexity of the tax function, transaction costs and the existence of investment opportunities due to market imperfections. As taxes and financial distress costs have attracted the interest of many researchers, there is less evidence, especially in China, on the effects of market transparency and managerial ownership as

determinants of derivative usage. As Smith and Stulz (1985) and Gay and Nam (1998) have mentioned, the agency problems existing between managers and shareholders results in underinvestment, which would affect the investment opportunities of the firms. It would therefore be interesting to examine the effect of agency problems and information transparency on the use of derivatives in China, whose financial market has some particular characteristics. The hypothesis in the first part of the study is to test whether agency problems affect the use of foreign currency derivatives when firms experience information asymmetry. As the data disclosed by Chinese firms is inconsistent, this study estimates the probit regression by using a binary variable to proxy the use of foreign currency derivatives. This differs to Bartram, Brown and Fehle (2009) who have focused on multiple types of derivative instruments, as I examine the determinants of foreign currency derivatives only. Therefore, the degree of foreign sales is also included as one of the determinants of derivatives usage. The model specification is as follows:

$$FCD_{it} = \beta_1 EXP_{it} + \beta_2 AGENCY_{it} + \beta_3 INFORMATION_{it} + \gamma CONTROL_{it} + \alpha_i + u_{it} \quad (5.1)$$

The dependent variable, shown on the left-hand side, is the use of derivatives of each firm during the sample period. It is equal to 1 when the firm i chooses to use foreign currency derivatives in year t and 0 when firm i does not use foreign currency derivatives. (the subscript i refers to each firm in the sample and t refers to each year of the sample period.) On the right-hand side, EXP_{it} represents the ratio of foreign sales to total sales of the firm i in year t, called the export ratio to estimate the degree of foreign sales of the firm. This study considers this variable as one of the determinants of using foreign currency derivatives because the derivatives will tend to be used by firms with a large foreign risk exposure. Allayannis and Ofek (2001) found that firms have a large foreign exchange exposure if they have a greater export ratio, which is similar to using the extent of foreign sales as one of the factors which could influence the foreign currency derivative usage. $AGENCY_{it}$ refers to a measure of the agency problems of the firm i in year t, measured by ownership structure in this study, including the ownership concentration and agency costs, which was also used by Fauver and Naranjo (2010) and Marshall, Kemmitt and Pinto (2013). Additionally, I will consider whether state-owned and private firms show different evidence on the hedging decision. $INFORMATION_{it}$ indicates the transparency of information and measures the asset's

opaqueness. The greater the asset's opaqueness the more likely are the investors to take advantage of private information, which could harm the efficiency of the market. $CONTROL_{it}$ represents a vector of exogenous variables representing the firm's characteristics, such as size, leverage and debt capacity, which are explained in detail during the next section. α_i refer to individual effects which are constant over time and the u_{it} are assumed to be normally distributed error terms in the random effects model.

5.3.2 The dynamics of derivative usage

The second part of the chapter studies the dynamics of derivative usage as the foreign currency derivatives usually involve long contracts to hedge long-term exchange rate risk. The firms would consider whether they have the professional knowledge to use foreign currency derivatives and the existing derivatives owned by the firm and their efficiency in mitigating the exchange exposure when they make the decision to use foreign currency derivatives. Thus, it is important to add the lagged dependent variable into the previous equation because the behaviour during the past year is one of the most important factors relating to the firm's risk management strategies for the next year. Stewart (2006) proposed a stata program of the random effects dynamic probit model implementing the Heckman estimator in a more convenient way and allowing for the endogeneity in the specification. Moreover, as the probit panel model is not appropriate with the fixed effects to be conditioned out of the likelihood and Stewart (2006) employed a random effects probit model to cotrol for the edogeneity, the random effects model has been adopted for this study, as supported by Frain (2008). The reason Stewart uses random effects are due to some of the problems with fixed effects in this type of model. As Baltagi (1995) proposed, the probit model does not lend itself to a fixed effects treatment, it often fails to yield finite predictions for the fixed effects by using the standard estimation methods for the probit model, such as the maximum likelihood estimation. Also, the sample used in the study has a large N and small T, which would produce problems with the fixed effects in a dynamic panel model, as suggested by Baltagi (1995) and Kunz et al. (2019). Meanwhile, this study will make comparisons between this model and the standard random effects probit program which could overestimate the effect of the lagged variables when the dynamic model is considered.

Following Stewart's (2006)'s approach, the latent equation for the random effects dynamic model is shown below:

$$FCD_{it}^{*} = \rho FCD_{it-1} + \beta_1 EXP_{it} + \beta_2 AGENCY_{it} + \beta_3 INFORMATION_{it} + \gamma CONTROL_{it} + \alpha_i + u_{it} \quad (5.2)$$

$$FCD_{it} = \begin{cases} 1, & FCD_{it}^{*} \geq 0 \\ 0, & FCD_{it}^{*} < 0 \end{cases}$$

FCD_{it}^{*} is the latent dependent variable and FCD_{it} is the observed binary variable which is equal to 1 when the firm uses foreign currency derivatives and 0 otherwise. To explore the dynamic effect, the lagged dependent variable is included on the right hand side and FCD_{it-1} represents the derivatives usage from the previous period. The second part will focus on the lagged effect of derivatives usage on the current decision and the null hypothesis is $\rho = 0$. Thus the expected conclusion would be to reject the null hypothesis and therefore the derivatives usage from previous periods would affect the current strategies on using foreign currency derivatives. In the dynamic model, the initial conditions are an important part to consider. As suggested by Stewart (2006), the standard probit model assumes the initial observation to be uncorrelated with the individual effects, resulting in an inconsistent estimator due to existing endogeneity in most cases, while the Heckman estimator specified the initial conditions as a linear reduced form consisting of a vector of exogeneous variables to solve the initial conditions problem. In this part I will also compare different dynamic probit models and it is expected that the Heckman estimator would perform better than the standard estimator as the initial conditions problem is solved by the use of the Heckman approach in the estimation.

To simplify equation (5.2), the model specification uses X_{it} to represent a vector of explanatory variables, containing the main variables and control variables, the new equation could be written as:

$$FCD_{it}^{*} = \rho FCD_{it-1} + \beta X_{it} + \alpha_i + u_{it} \quad (5.3)$$

The composite error term could be represented by,

$$\varepsilon_{it} = \alpha_i + u_{it} \quad (5.4)$$

$$Corr(\varepsilon_{it}, \varepsilon_{ij}) = \frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_u^2} \qquad t, j = 2, \dots T \; t \neq j. \tag{5.5}$$

The standard normal probit random effects model applies this model with the assumption that the composite error term is uncorrelated with the independent variables, which means no correlation between the unobserved effects and explanatory variables. However, this assumption is not true in most empirical cases. Stewart (2006) chose the Mundlak-Chamberlain approach that allows for the relationship between the time-invariant individual effects and the explanatory variables. This approach used either the time means of the explanatory variables or a combination of their lags and leads to represent the time-invariant individual effects, for example, $\alpha_i = \overline{X_i} b + \delta_i,\ \delta_i \sim iid$. Then, α_i is replaced by equation (5.3) and the transition probability of the derivative usage given by the derivatives usage from the last period, the other explanatory variables and individual effects for each firm are estimated by the following equation (5.6), where Φ is the cumulative normal distribution function.

$$[FCD_{it} | x_{it}, FCD_{it-1}, \alpha_i] = \Phi[(\rho FCD_{it-1} + \beta X_{it} + \alpha_i)(2FCD_{it} - 1)] \tag{5.6}$$

Turning to the initial conditions problem, which exists due to the correlated effects between the initial observed parameters and time-invariant individual effects in most empirical studies and which would lead to inconsistent estimators. In the normal random effects model, the initial values are assumed to be exogeneous, which is not appropriate in many cases. To solve the initial values problem, Stewart (2006) follows Heckman's method to generate a linearized reduced form of the individual effects and puts this into the original equation so as to improve the consistency of the estimator. Thus, the derivative usage of firms when $t = 1$ are represented by a linear relationship with a vector of exogenous instrumental variables. It can be shown as:

$$FCD_{i1}^{\ *} = \mu Z_{i1} + \theta_i, i = 1, \dots, N \tag{5.7}$$

where Z_{i1} is a vector of exogenous instrumental variables and $\theta_i$is correlated with the time-invariant individual effects but is independent of the error term u_{it} for $t \geq 2$. Then, using orthogonal projections, it can be represented by equation (5.8).

$$\theta_i = a\alpha_i + u_{i1} \tag{5.8}$$

Thus, replacing θ_i in equation (5.7) by equation (5.8), the latent dependent variable for the first period can be written as;

$$FCD_{i1}{}^{*} = \mu Z_{i1} + a\alpha_i + u_{i1}, i = 1, \dots, N \tag{5.9}$$

Following Heckman's method to solve the initial conditions problem, the joint probability of the observed foreign currency derivative usage for each firm given unobserved time-invariant individual effects, could be written as:

$$\Phi[(\mu Z_{i1} + a\alpha_i)(2FCD_{i1} - 1)] \prod_{t=2}^{T} \Phi[(\rho FCD_{it-1} + \beta X_{it} + \alpha_i)(2FCD_{it} - 1)] \tag{5.10}$$

Applying the maximum likelihood estimation approach proposed by Heckman(1987), the maximum likelihood for firms is given by,

$$\prod_i \int_{\alpha^*} \left\{ \Phi[(\mu Z_{i1} + a\sigma_\alpha \alpha^*)(2FCD_{i1} - 1)] \prod_{t=2}^{T} \Phi[(\rho FCD_{it-1} + \beta X_{it} + \sigma_\alpha \alpha^*)(2FCD_{it} - 1)] \right\} dF(\alpha^*) \tag{5.11}$$

$$where\ \alpha^* = \frac{\alpha}{\sigma_\alpha}, \sigma_\alpha = \sqrt{\rho/(1-\rho)}$$

F is the distribution function of α^* and α and is assumed to be normally distributed. The Gaussian-Hermite quadrature can be used to calculate the integral over α^*. Based on the Heckman approach, which allows for unobserved heterogeneity and employs the maximum likelihood estimation to solve the initial conditions problems, Stewart (2006) produced a Stata program to obtain this Maximum Likelihood estimator by using a more convenient way thus

this study intends to use this method to analyse the dynamics of foreign currency derivatives usage.

5.4 Data description

This study focuses on identifying the characteristics of the firms that choose to use derivatives in China, the sample is chosen from the Shenzhen stock exchange market, which is one of the main markets in China. As there have been increasing foreign exchange risks for Chinese firms in recent times, firms are more likely to use foreign currency derivatives, especially in the manufacturing industry which has larger import and export sales. In addition, disclosure of foreign currency derivative usage is clearer and more complete than other derivatives based on different underlying assets. Thus, we chose listed firms in the manufacturing industry, which is classified by CSRC (China Securities Regulatory Commission), and collected the data related to the use of forward contracts, swaps and futures whose underlying asset is foreign currency from each of the company's annual reports. Due to concentrating on the use of foreign currency derivatives, only multinational corporations (MNCs) are considered in this study, as is the case in Allayannis and Ofek (2001) and Pantzalis, Simkins and Laux (2001). MNCs have been selected by choosing firms with a ratio of foreign sales to total sales which is greater than 10%. After excluding the firms with incomplete information and firms with extremely limited data, I obtained 316 firms data running from 2012 to 2017. All the accounting data has been obtained from the Wind database while the use of derivatives is hand-collected by checking the annual reports of each firm each year.

5.4.1 The dependent variable

The dependent variable in equation (5.1) is the use of foreign currency derivatives. We assign a value of 1 when the firm used foreign currency derivatives to hedge that year and the value 0 when the firm did not use any foreign currency derivatives. This binary variable was commonly employed in similar empirical studies, such as Nance, Smith Jr and Smithson (1993), Hagelin (2003) and Bartram, Brown and Conrad (2011). Some studies have used a continuous variable to proxy derivatives usage. For instance, Berkman and Bradbury (1996) and Allayannis and Ofek (2001) scaled the notional value of derivative contracts to proxy for derivatives usage. However, it is not suitable to use a continuous variable in this case as a result of the incomplete information and inconsistent disclosure among firms. In equation (5.2), the lagged dependent variable is taken as the explanatory variable to test its effect on current decisions regarding derivative usage.

5.4.2 The extent of foreign sales, agency costs and information asymmetry

The extent of foreign sales is measured by the ratio of foreign sales to total sales in each year, which also indicates the extent of multinationality. As Allayannis and Ofek (2001) have provided evidence that firms are more likely to use foreign currency derivatives when they face greater foreign exchange exposure, it is expected that the probability of using foreign currency derivatives rises with an increasing export ratio, which implies firms will hedge with foreign currency derivatives when they have a large proportion of foreign sales. As foreign exchange rates become to float, foreign exchange risk to firms is not limited to a country level. With expansion of foreign business, firms are more likely to hedge with foreign currency derivatives to reduce foreign exchange exposure. Thus, I expect that there is a positive relationship between the level of foreign involvement and the use of foreign currency derivatives.

Another important factor is information asymmetry, which is measured by the ratio of intangible assets to total assets. Information asymmetry could motivate managers to hedge since other firms or investors would take advantage of private information to enhance competence and earn abnormal returns. Intangible assets to assets measures the extent of the assets opaqueness, which will decrease the transparency of information in the capital market as noted by Aboody and Lev (2000) and Fauver and Naranjo (2010).

The agency problem is a problem in capital markets, which means that it is difficult to deal with conflicts in benefits between shareholders and managers. Smith and Stulz (1985) illustrated that hedging can be helpful to reduce agency costs, which implies that agency problems could be one incentive to use derivatives. As a result, agency problems are taken as one of the main determinants of foreign currency derivative usage. There are two proxies for measuring the agency problem. Ownership concentration, including institutional ownership and insider ownership, which has been used to estimate firm ownership, while agency cost is measured by the ratio of total sales to total assets, as in Fauver and Naranjo (2010), indicating that firms with a lower ratio of sales to total assets have a higher propensity to use derivatives because lower agency costs allow managers to concentrate on investments with higher returns. As derivatives markets in US are developed with a variety of products and provide with sufficient flexibility. Firms with agency problems are more likely to use currency derivatives to pursue own interests. Howeber, it would be expected that firms use derivatives to reduce

conflicts between shareholders and excecutives when facing risks of investments due to the limited products in the derivatives market. Based on the evidence that higher insider ownership and lower institutional ownership represent higher agency problems from McConnell and Servaes (1990) and Chen, Harford and Li (2007), the expected result is a nonlinear relationship between agency problems and the use of foreign currency derivatives or market value of firms. Furthermore, as the majority of firms were state-owned in China before 2002, state's ownership is an interesting factor which possibly affects the firm's hedging strategies. A dummy variable is employed to represent the firm's ownership. The variable is equal to 1 if the firm is directly owned by the state or the largest shareholder is a state-owned company otherwise it is zero representing for private firms.

5.4.3 Control variables

Based on the study of Geyer-Klingeberg, Hang and Rathgeber (2019), the most common control variables relate to differences in firms' characteristics, including size, leverage, the quick ratio, financial distress costs, operating income and growth opportunities.

Size is measured by taking the logarithm of total assets, which helps to scale the data. The size effect on derivatives usage remains controversial. The majority of studies indicate larger firms are more likely to use derivatives due to large exchange rate exposure. The capital structure is captured by the leverage, which is a proxy for the probability of financial distress and closely associated with the probability of hedging thus it is controlled for in the regression, being measured by total debt to total assets. Smith and Stulz (1985) illustrated that greater financial stress is more likely to motivate firms to make hedging decision. As a result, debt to earnings before interest, taxes, depreciation and amortization(EBITDA) is used to measure the firm's ability to pay off the incurred debt. The quick ratio, the ratio of current assets to current liabilities, is used to measure the short-term liquidity of the firm, and it is directly collected from the data base. Then the ratio of operating income to sales and the ratio of capital expenditure to sales are used to proxy for the growth opportunities. The probability of using derivatives is higher for firms with higher growth since they are more likely to hedge risk and invest in productive projects. The use of these control variables are supported by Allayannis and Ofek (2001), Allayannis and Weston (2001), Purnanandam (2008) and Bartram, Brown and Fehle (2009). This study predicts that these control variables should be significantly

associated with foreign currency derivative usage and firm value, although alternatively they may not be statistically significant due to the inefficiency of the Chinese capital market.

5.5 Empirical results

5.5.1 Summary descriptive statistics

Table 5.1 summarizes the descriptive statistics of the data. The hedging data was totally hand collected from the accounts for 316 firms after excluding firms with incomplete information and outliers. The binary variable is assigned the value of 1 if the firm used foreign currency forwards, swaps or futures and 0 otherwise. Over the sample time period, from 2012 to 2017, on average approximately 40% of the total firms used foreign currency derivatives. The number of users (firms with foreign currency derivatives) was increasing before 2015 and then decreased. By observing differences between users and non-users, we find that the degree of foreign sales is obviously higher for users than non-users, which suggests that firms with a higher proportion of foreign business are more likely to use foreign currency derivatives.

Focusing on the proxy for information asymmetry and agency problems, we use the ratio of intangible assets to total assets to represent information asymmetry and ownership concentration and sales to total assets to measure agency problems. It appears that users have more problems with information and agency, which is very different from other studies and raises some important questions about Chinese corporate finance. For the control variables, leverage, the quick ratio and the ration of debt to earnings before interest, tax, depreocoation and amortization, do not show distinct differences between users and non-users, but the average of users' total assets is higher than non-users' over the sample period. As we expected firms using foreign currency derivatives have higher assets than firms who do not use derivatives. The operating income to total sales is used to measure the profitability of firms and according to the descriptive statistics, non-users tend to have lower profitability than users. However, there is an opposite result for the growth opportunities of firms, which is measured by capital expenditure to total assets. On average, users have less growth opportunities than non-users over the sample period.

Table 5.1 Descriptive statistics

	2017		2016		2015		2014		2013		2012	
	users	non-users	users	non-users	users	non-users	users	non-users	users	non-users	users	non-users
FCD	94	222	94	222	101	215	97	219	76	240	69	247
Foreign sales/million, yuan	5,251	1,309	4,227	1,009	3,640	957	3,054	1,103	3,294	883	3,423	746
Total sales/million, yuan	14,071	4,914	11,326	3,755	9,563	3,495	8,241	4,411	8,450	4,011	8,479	3,600
Total assets/million, yuan	19,833	8,802	17,137	7,620	12,480	6,878	9,348	6,999	9,022	5,842	9,000	5,110
Export ratio	0.442	0.285	0.437	0.302	0.440	0.298	0.428	0.302	0.478	0.294	0.517	0.294
Quick ratio	1.319	1.773	1.558	1.813	1.793	1.622	2.321	1.796	3.518	1.820	2.437	2.317
Debt/EBITDA	3.456	4.190	5.028	0.786	1.742	3.823	2.908	2.954	3.826	7.286	4.037	-1.653
Information asymmetry	0.054	0.044	0.058	0.046	0.054	0.049	0.051	0.048	0.049	0.048	0.049	0.047
Internal ownership	0.322	0.293	0.337	0.290	0.341	0.309	0.360	0.326	0.368	0.343	0.375	0.354
Institutional ownership	0.444	0.343	0.446	0.356	0.423	0.355	0.431	0.342	0.419	0.343	0.310	0.320
Operating income to sales	0.067	0.060	0.070	0.029	0.056	0.010	0.070	0.044	0.064	0.034	0.061	0.051
Leverage	0.286	0.233	0.273	0.212	0.239	0.237	0.241	0.244	0.238	0.264	0.222	0.245
Sales to assets	0.686	0.571	0.679	0.519	0.724	0.538	0.763	0.598	0.803	0.624	0.832	0.626
Capital expenditure to sales	1.679	2.758	1.315	3.273	1.661	3.845	0.749	1.636	0.583	1.820	0.654	1.490

Note: FCD represents the number of firms using foreign currency derivative; Export ratio refers to the ratio of foreign sales to total sales; Leverage is the ratio of total debt to total equity; The ratio of debt to EBITDA is measured by the ratio of debt to earnings before interest, taxes, depreciation and amortization; Information asymmetry is estimated by intangible assets to total assets; Internal ownership indicates the proportion of the value of the first shareholder; Institutional ownership represents the institutional ownership concentration of firms.

Table 5.2 Correlations

Variables	FCD	EXP	SIZE	OI/ SALES	CAPEX/ SALES	QR	LEVERAGE	DEBT/ EBITDA	IA/ ASSETS	INTERNAL OWNERSHIP	INSTITUTIONAL OWNERSHIP	SALES/ ASSETS
FCD	1											
EXP	0.313***	1										
	(0.000)											
SIZE	0.176***	-0.081***	1									
	(0.000)	(0.000)										
OI/SALES	0.085***	0.076***	0.059***	1								
	(0.000)	(0.001)	(0.000)									
CAPEX/SALES	-0.087***	-0.013***	-0.074***	-0.694***	1							
	(0.000)	(0.000)	(0.000)	(0.000)								
QR	0.028***	0.113***	-0.161***	0.148***	0.001***	1						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)							
LEVERAGE	0.026***	-0.041***	0.429***	-0.292***	0.067***	-0.293***	1					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)						
DEBT/EBITDA	0.006**	-0.008**	0.052***	-0.002***	-0.024***	-0.017***	0.043***	1				
	(0.010)	(0.024)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
IA/ASSETS	0.056**	0.000***	-0.057***	-0.080***	0.070***	-0.008***	-0.012***	0.032***	1			
	(0.016)	(0.001)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)				
INTERNAL OWNERSHIP	0.092***	0.034***	0.069***	0.082***	-0.079***	0.012***	-0.031***	-0.003***	-0.042***	1		

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
INSTITUTIONAL OWNERSHIP	0.145***	0.140***	0.282***	0.028***	-0.034***	-0.041***	0.070***	0.018***	-0.043***	0.358***	1	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
SALES/ASSETS	0.230***	-0.014***	0.097***	0.050***	-0.188***	-0.158***	0.054**	0.000**	-0.064***	0.160***	0.203***	1
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.019)	(0.023)	(0.005)	(0.000)	(0.000)	

Note: ***,**,* represents 1%, 5%, and 10% significance level. EXP, SIZE, OI/SALES, CAPEX/SALES, QR, IA/ASSETS refer to the ratio of foreign business to total sales, the logarithm of total assets, the ratio of operating income to total sales, the ratio of capital expenditure to total sales, quick ratio and intangible assets to total assets.

Table 5.2 presents the correlation coefficients of the paired variables in the sample, which could help us build an intuition about the determinants of foreign currency derivatives usage and ensure there is not a problem with multicollinearity. As we can see from the table, all of correlations between paired variables are below 0.5. With particular interest in our expected determinants of hedging, we focus on the correlation between the export level, information asymmetry proxy, agency problems and the use of foreign currency derivatives. The level of exports is positively related to the foreign currency derivative usage, which is consistent with our expectation as more oversea business would mean the firms are exposed to more risks. Focusing on the proxies for information transparency, we find that intangible assets has a positive correlation with foreign currency derivative use, which is consistent with Fauver and Naranjo (2010)'s findings that firms with more opaque assets are more likely to use derivatives. However, mixed results of agency problems are obtained from the correlation table. Three proxies for agency problems, internal ownership, external ownership and sales to total assets, show a positive correlation with the use of derivatives but they imply opposite meanings. A higher proportion of institutional shares and a higher ratio of sales to total assets suggests better firm monitoring and less agency problems while higher levels of internal ownership indicates more concentrated ownership structures which would lead to higher agency costs. Looking at other firm characteristics, we find the firm size, profitability and liquidity is positively linked to the derivatives use while it is negatively related to the growth opportunities, proxied by the ratio of capital expenditures to total sales. Leverage and the debt to EBITDA correlation patterns suggest that a higher debt load is related to hedging. The correlations table only gives a brief understanding of factors that could influence firms' decision on using foreign currency derivatives and so we move to estimations with probit model.

5.5.2 The determinants of the use of foreign currency derivatives

The first stage of this chapter is to find factors that could determine the use of foreign currency derivatives for multinational corporations. We first employ a simple t-test for the difference of the average of variables across foreign currency derivative and non-derivative using firms. It can be seen from Table 5.3 that firms that use derivatives tend to have a significantly larger size, higher profitability and less growth opportunities, which is consistent with the results from Table 5.2, while there is no significant difference in the quick ratio, debt to EBITDA and leverage. Focusing on the variables of interest, we observe that the level of exports of the firms using derivatives is significantly higher than firms not using derivatives. Also, the table shows

the firms using derivatives have more opaque assets at the 5% significance level. Firms not using derivatives have a significantly lower proportion of first share holders and a lower proportion of institutional ownership.

However, the results from Table 5.2 and Table 5.3 are only suggestive of a relationship between the expected determinants and the foreign currency derivative usage as firm's individual effects are not controlled for in this estimation. As a result, I have employed the probit model to examine the determinants of foreign currency derivative usage while controlling for the firm heterogeneity. The degree of foreign sales, measured by the export ratio, is the main determinant we are focusing on. Thus, specification (1) is the base model containing the main variable and control variables. Considering the existence of information asymmetry and agency problems in the financial markets, specification (2) and (3) adds variables which are a proxy for the information transparency and agency problems respectively to identify whether they affect foreign currency derivatives usage. Specification (4) includes all the addressed factors and control variables into the regression. I have used the probit model with robust standard errors clustered by firm and year. Table 5.4 summarizes the results of the four different specifications across columns and Table 5.5 provides average marginal effects on derivatives usage.

Table 5.3 Simple T-test

	Non-Users	Users	Difference	t-test
EXP	0.296	0.453	-0.157	-14.318***
SIZE	15.047	15.462	-0.416	-7.762***
OPERATING INCOME/SALES	0.038	0.065	-0.026	-3.729***
CAPITAL EXPENDITURE/SALES	2.439	1.151	1.288	3.7912***
QR	1.866	2.095	-0.229	-1.207
LEVERAGE	0.240	0.251	-0.012	-1.140
DEBT/EBITDA	2.865	3.437	-0.572	-0.277
INTANGIBLE ASSETS/ASSETS	0.047	0.053	-0.006	-2.419**
INTERNAL OWNERSHIP	0.320	0.349	-0.028	-4.024***
INSTITUTIONAL OWNERSHIP	0.343	0.417	-0.075	-6.368***
SALES/ASSETS	0.581	0.742	-0.161	-10.263

Note: Difference equals that the mean value of non-derivatives using firms minus the mean value of derivatives using firms. *, **, *** represents 10%, 5% and 1% significance level respectively.

In contrast to the previous literature, this paper additionally considers the proportion of the foreign sales to total sales as a determinant of derivatives usage. It can be seen from Table 5.4 that the coefficient on the export ratio is significant at the 1% level across all specifications, which implies that firms are more likely to employ risk management strategies by using foreign currency derivatives as the export ratio increases. As foreign sales take up a large proportion of total sales, firms would be more sensitive to changes in exchange rates. As a result, firms are more likely to choose foreign currency derivatives to reduce the risk of any exchange rate changes. In combination with results of the average effects from Table 5.5, the export ratio increases the probability of using currency derivatives approximately by 47.7%, which suggests that the degree of foreign business is one of the nontrivial motivations for hedging with foreign currency derivatives.

In terms of the control variables across different specifications, as we expected the firm size, measured by total assets, is positively related to the use of foreign currency derivatives at the 1% significance level. Large firms are more likely to have a higher probability of using foreign currency derivatives than small firms as large firms would have more foreign exchange exposure. As can be seen from Table 5.5, a 1% increase in size would improve the probability of derivatives usage by about 10%. From Tables 5.4 and 5.5, leverage and the ratio of debt to EBITDA do not show any significant effects in determining the use of derivatives, which is different to the previous literature, such as Fauver and Naranjo (2010). Also, it seems that liquidity, which is measured by the quick ratio, is not a significant determinant of derivative usage. Based on these results, the ratio of operating income to sales is not a significant factor that could affect derivatives usage, which indicates that the profitability of firms is not relevant to the use of foreign currency derivatives. However, the growth opportunity measure is a significant determinant of the use of derivatives as the significance of capital expenditures is shown in the Table 5.4, but not in the fourth specification which includes the measures for information asymmetry and agency problems together. In addition, the ratio of capital expenditures to total sales doesn't show average marginal effects on hedging with currency derivatives.

The results from assessing the effects of information asymmetry and agency problems, provide opposite results to Fauver and Naranjo (2010), who focused on the US study. In the second specification, intangible assets to total assets are used to represent the information asymmetry, which means that a higher ratio of intangible assets to total assets would result in severe

problems of information asymmetry. It can be seen from these results that greater problems of information asymmetry lead to a higher probability of using derivatives by firms at the 5% significance level and 1% significance level in the fourth specification. The results is different from US markets, which accounts for less efficiency of financial markets in China. Fauver and Naranjo (2010) found that firms exhibits less hedge with greater problems of information asymmetry as managers would use derivatives for speculation. However, the foreign exchange market in China has been well-controlled compared with US markets and the exchange rate is not much volatile as developed countries, which is not much profitable for speculation. Firms would like to hedge with currency deirvatives facing with information asymmetry problems. Additionally, Table 5.5 indicates that there is a positive marginal effect for intangible assets to assets on derivatives usage. The same conclusion occurs for agency problems in the third specification. Agency problems are measured by the ratio of sales to total assets and corporate insider and institutional ownership. We find that firms with higher sales to total assets are more likely to use foreign currency derivatives, but ownership concentration does not significantly affect derivative usage. Higher sales indicate of lower agency costs as managers are pursuing productive investments. Lower agency costs is linked to higher probality of the use of foreign currency derivatives, which means that firms are more likely to use hedging instruments with well corporate governance.

Regarding Tables 5.4 and 5.5, the fourth specification also includes the ratio of intangible assets to total assets and sales to total assets and it shows that the ratio of sales to assets is more sensitive to the use of foreign currency derivatives, but the ownership concentration does not affect the decision on using foreign currency derivatives. There are 27.5% (87/316) of firms that are state-owned companies in the sample. From Table 5.6, state ownership do not show any evidence on the use of foreign currency derivatives. Thus, this dummy variable is removed from the subsequent models. To summarize the results, a higher degree of foreign sales to total sales would motivate firms to use foreign currency derivatives and larger firms are more likely to use derivatives than small firms. Information asymmetry and agency problems affect the decision regarding using derivatives at certain levels, but the measure of these problems could be improved.

5.5.3 The dynamics of the use of foreign currency derivatives

Firms use derivatives to hedge for a long-term purpose thus the use of derivatives is expected to be associated with the decision from past periods. During the second stage of this paper, I explore the dynamic effect of derivative usage by manufacturing firms and make comparisons for different estimators. Focusing on the results from Table 5.6, the lagged dependent variable exhibits a significant effect at the 1% significance level over all four specifications by using two different approaches. At the same time, the size of the firm is still a significant determinant of currency derivatives usage. Information asymmetry measured by the intangible assets to total assets shows a positive effect at the 5% significance level on the decision to use derivatives in specification 2 and in specification 4 which contains all the explanatory variables. In specification 3 and 4, the higher ratio of sales to total assets representing the agency problems leads to a higher probability of using foreign currency derivatives. However, it seems that the ownership structures do not exhibit significant effects on derivatives usage.

Comparing the results from the standard estimation and the Heckman estimator, the Heckman estimation gives a further reduction in the coefficients of the lagged derivative usage across four different specification. For example, it is shown that under the standard estimation, which regards the initial conditions as the coefficient on the lagged dependent variable, it is 2.329 in specification 4. The coefficient experiences a 7% reduction by using the Stewart (2006) approach decreasing to 2.061. The estimated effects of all other explanatory variables are higher than the estimated effects from using the standard estimation. The difference between the two approaches is the way it treats the initial values. Stewart (2006) employed the Heckman estimator to treat the initial conditions as a linear relationship of exogeneous variables and allowed endogeneity in the model while the standard random effects probit model has strict exogeneity assumptions for the initial conditions. Therefore, it can be seen from the results that the lagged effects have been better scaled by using Stewart (2006)'s approach.

The results from Table 5.7 show that the use of foreign currency derivatives is not affected by whether it is a state-owned firms or not. Table 5.8 presents the various robustness tests for the dynamic probit model by including the exchange rate and a non-linear exports variable in the regressions. The exchange rate is represented by the amounts of Renminbi per dollar over the sample period. Overall the results have not changed with the lagged derivatives usage being significantly related to current hedging decisions and also the level of exports and the firm size remain significant effects on the use of derivatives across different specifications. Furthermore,

as expected the use of derivatives is negatively related to the exchange rate, which suggest that firms are more likely to hedge with derivatives when the Renminbi has appreciated to a high level, as this could create an expectation of a future depreciation so incurring a potential future loss to the firm unless it hedges.

The inclusion of the squared export term alongside the linear export term, to account for any non-linear relationship between exports and derivative use produces a negative squared term, however it is only significant at 10%, whilst the non-squared term remains positive and significant. This suggests a weak inverted U shaped relationship between exports and derivative use as expected, with derivative use rising initially as exports rise, but then declining for larger exporters as they are able to hedge internally. Meanwhile Table 5.9 presents the results from the models that include additional proxies for agency problems and asymmetric information. Following Javakhadze et al.(2014), the study includes the ratio of market value-to-book value and the ratio of cash flow to total assets as proxies for agency problems. Firms with a lower ratio of market-to-book value indicates greater agency problems as firms have excess cash which can be invested in profitable investments. These proxies are also used by Fauver and Naranjo(2010). Moreover, the study adds firms characteristics, such as the firm's age, the number of employee and the growth rate of the firm, into the regression to control for asymmetric information. The main results obtained from estimating the effects of the ratio of sales to assets and the ratio of intagibles assets to assets arenot affected by including the additional proxies.

Table 5.4 Determinants of foreign currency derivatives: Static Model

	(1)	(2)	(3)	(4)
EXP	3.837***	3.773***	3.783***	3.704***
	(5.99)	(5.79)	(6.05)	(5.82)
SIZE	0.749***	0.768***	0.760***	0.779***
	(5.26)	(5.33)	(5.50)	(5.54)
LEVERAGE	-0.515	-0.474	-0.581	-0.541
	(-0.97)	(-0.84)	(-1.19)	(-1.03)
QR	0.015	0.017	0.019	0.021
	(0.88)	(1.00)	(1.11)	(1.28)
DEBT/EBITDA	0.0011	0.0009	0.0010	0.0008
	(0.79)	(0.70)	(0.77)	(0.65)
OPERATING INCOME/SALES	-0.503	-0.459	-0.605	-0.574
	(-0.56)	(-0.53)	(-0.68)	(-0.66)
CAPITAL EXPENDITURE/SALES	-0.040*	-0.041*	-0.033*	-0.035
	(-1.77)	(-1.72)	(-1.65)	(-1.63)
INTANGIBLE ASSETS/ASSETS		5.816**		6.055***
		(2.44)		(2.61)
INTERNAL OWNERSHIP			0.173	0.217
			(0.20)	(0.24)
INSTITUTIONAL OWNERSHIP			0.509	0.578
			(1.28)	(1.45)
SALES/ASSETS			0.977***	0.996***
			(2.92)	(2.92)
CONSTANT	-14.05***	-14.62***	-14.99***	-15.63***
	(-6.25)	(-6.42)	(-6.82)	(-6.95)
Pseudo R-squared	0.28	0.37	0.38	0.38
Robust	√	√	√	√
N	1896	1896	1896	1896

Note: *, **, *** represents 10%, 5% and 1% significance levels respectively; t statistics are shown in parentheses. There are four specifications, specification 1 is the base model and then the specification 2 includes variables of information asymmetry only. Specification 3 contains agency problems measurements. Specification 4 is the full model including both variables of information asymmetry and agency problems.

Table 5.5 Average Marginal effects

	(1)	(2)	(3)	(4)
EXP	0.482***	0.469***	0.485***	0.471***
	(6.66)	(6.37)	(6.78)	(6.46)
SIZE	0.0941***	0.0955***	0.0975***	0.0990***
	(5.84)	(5.92)	(6.33)	(6.39)
LEVERAGE	-0.0647	-0.0589	-0.0745	-0.0687
	(-0.96)	(-0.84)	(-1.18)	(-1.03)
QR	0.00192	0.00215	0.00238	0.00270
	(0.88)	(1.01)	(1.11)	(1.28)
DEBT/EBITDA	0.000138	0.000118	0.000127	0.000106
	(0.80)	(0.70)	(0.77)	(0.65)
OPERATING INCOME/SALES	-0.0631	-0.0570	-0.0777	-0.0729
	(-0.56)	(-0.53)	(-0.68)	(-0.66)
CAPITAL EXPENDITURE/SALES	-0.00504	-0.00510	-0.00417	-0.00439
	(-1.74)	(-1.70)	(-1.64)	(-1.62)
INTANGIBLE ASSETS/ASSETS		0.723*		0.769**
		(2.48)		(2.64)
INTERNAL OWNERSHIP			0.0221	0.0276
			(0.20)	(0.24)
INSTITUTIONAL OWNERSHIP			0.0654	0.0734
			(1.30)	(1.47)
SALES/ASSETS			0.125**	0.127**
			(2.88)	(2.85)
N	1896	1896	1896	1896

*, **, *** represents 10%, 5% and 1% significance levels respectively; t statistics are shown in parentheses. There are four specifications, specification 1 is the base model and then the specification 2 includes variables of information asymmetry only. Specification 3 contains agency problems measurements. Specification 4 is the full model including both variables of information asymmetry and agency problems.

Table 5.6 The dynamics of foreign currency derivatives usage

	(1)		(2)		(3)		(4)	
	Standard	Heckman	Standard	Heckman	Standard	Heckman	Standard	Heckman
L.FCD	2.377***	2.196***	2.380***	2.073***	2.327***	2.073***	2.329***	2.061***
	(14.65)	(17.98)	(15.55)	(8.95)	(15.57)	(9.64)	(16.31)	(9.66)
EXP	1.130**	1.291***	1.140**	1.168***	1.148**	1.159***	1.159***	1.183***
	(1.98)	(5.62)	(2.17)	(3.79)	(2.45)	(3.76)	(2.68)	(3.88)
SIZE	0.189**	0.205***	0.194**	0.220***	0.165**	0.184***	0.170**	0.192***
	(2.21)	(3.87)	(2.38)	(3.17)	(2.26)	(2.72)	(2.40)	(2.79)
LEVERAGE	-0.033	-0.053	-0.024	0.012	0.056	0.078	0.061	0.086
	(-0.12)	(-0.18)	(-0.09)	(0.04)	(0.21)	(0.25)	(0.23)	(0.26)
QR	-0.001	0.000	-0.001	0.001	0.003	0.005	0.004	0.005
	(-0.12)	(0.01)	(-0.12)	(0.07)	(0.44)	(0.32)	(0.49)	(0.33)
DEBT/EBITDA	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.39)	(-0.52)	(-0.45)	(-0.48)	(-0.36)	(-0.35)	(-0.42)	(-0.44)
OPERATING INCOME/SALES	-0.128	-0.079	-0.186	0.002	0.069	0.186	0.016	0.147
	(-0.25)	(-0.14)	(-0.37)	(0.00)	(0.12)	(0.31)	(0.03)	(0.24)
CAPITAL EXPENDITURE/SALES	-0.030*	-0.030*	-0.037*	-0.034*	-0.018	-0.017	-0.023	-0.022
	(-1.65)	(-1.78)	(-1.77)	(-1.75)	(-1.19)	(-1.05)	(-1.28)	(-1.18)
INTANGIBLE ASSETS/ASSETS			2.572**	2.887**			2.753**	3.101**
			(2.08)	(2.35)			(2.14)	(2.47)
INTERNAL OWNERSHIP					0.206	0.224	0.212	0.231
					(0.53)	(0.56)	(0.54)	(0.57)
INSTITUTIONAL OWNERSHIP					0.266	0.344	0.266	0.348
					(1.10)	(1.33)	(1.12)	(1.32)
SALES/ASSETS					0.461**	0.441**	0.477**	0.472**
					(1.97)	(2.27)	(2.03)	(2.38)
CONSTANT	-4.605**	-4.882***	-4.805***	-5.232***	-4.757***	-5.065***	-4.976***	-5.367***
	(-3.09)	(-6.12)	(-3.33)	(-4.67)	(-3.48)	(-4.53)	(-3.72)	(-4.65)
N	1580	1580	1580	1580	1580	1580	1580	1580

Note: *, **, *** represents 10%, 5% and 1% significance levels respectively; t statistics are shown in parentheses. There are four specifications, specification 1 is the base model and then the specification 2 includes variables of information asymmetry only. Specification 3 contains agency problems measurements. Specification 4 is the full model including both variables of information asymmetry and agency problems.

Table 5.7 The dynamics of foreign currency derivatives: state-owned

	Standard	Heckman
L.FCD	2.376***	2.196***
	(13.95)	(17.96)
EXP	1.130*	1.290***
	(1.93)	(5.62)
SIZE	0.192*	0.206***
	(1.94)	(3.63)
LEVERAGE	-0.0365	-0.0539
	(-0.13)	(-0.18)
QR	-0.00101	0.000112
	(-0.13)	(0.01)
DEBT/EBITDA	-0.000812	-0.000775
	(-0.39)	(-0.52)
OPERATING INCOME/SALES	-0.148	-0.0847
	(-0.27)	(-0.15)
CAPITAL EXPENDITURE/SALES	-0.0298	-0.030*
	(-1.62)	(-1.78)
STATEOWN	-0.0182	-0.00493
	(-0.14)	(-0.04)
CONSTANT	-4.645***	-4.893***
	(-2.78)	(-5.84)
N	1580	1580

*, **, *** represents 10%, 5% and 1% significance levels respectively; t statistics are shown in parentheses. STATEOWN is equal to 1 if the firm is state-owned and 0 otherwise.

Table 5.8 Robustness checks for the dynamic model: Exchange rates

	(1)	(2)	(3)	(4)	(5)
Lag. FCD	2.239***	2.250***	2.221***	2.223***	2.199***
	(18.18)	(18.33)	(16.03)	(16.12)	(18.13)
EXP	1.286***	1.289***	1.281***	1.295***	2.703***
	(5.60)	(5.62)	(4.74)	(4.81)	(3.32)
SIZE	0.238***	0.242***	0.216***	0.221***	0.206***
	(4.35)	(4.41)	(3.53)	(3.60)	(3.90)
LEVERAGE	-0.128	-0.121	-0.028	-0.020	-0.029
	(-0.43)	(-0.40)	(-0.09)	(-0.06)	(-0.10)
QR	-0.001	-0.001	0.003	0.004	0.001
	(-0.07)	(-0.07)	(0.24)	(0.28)	(0.04)
DEBT/EBITDA	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.54)	(-0.62)	(-0.44)	(-0.54)	(-0.58)
OPERATING INCOME/SALES	0.013	-0.044	0.146	0.095	-0.052
	(0.02)	(-0.08)	(0.26)	(0.16)	(-0.10)
CAPITAL EXPENDITURE/SALES	-0.025	-0.031	-0.016	-0.020	-0.029
	(-1.52)	(-1.69)	(-0.95)	(-1.10)	(-1.73)
ER	-0.548***	-0.546***	-0.496**	-0.488**	
	(-2.84)	(-2.82)	(-2.51)	(-2.46)	
INTANGIBLE ASSETS/ASSETS		2.565*		2.898***	
		(2.47)		(2.62)	
INTERNAL OWNERSHIP			0.131	0.133	
			(0.35)	(0.35)	
INSTITUTIONAL OWNERSHIP			0.346	0.349	
			(1.41)	(1.41)	
SALES/ASSETS			0.455**	0.479***	
			(2.55)	(2.66)	
EXPSQ					-1.577*
					(-1.82)
CONSTANT	-1.879	-2.072	-2.389	-2.677	-5.134***
	(-1.43)	(-1.56)	(-1.67)	(-1.85)	(-6.34)
N	1580	1580	1580	1580	1580

*, **, *** represents 10%, 5% and 1% significance levels respectively; t statistics are shown in parentheses. There are five specifications, specification 1 is the base model and then the specification 2 includes variables of information asymmetry only. Specification 3 contains agency problems measurements. Specification 4 is the full model including both variables of information asymmetry and agency problems. Specification 5 adds the the squared of export ratio to regression, which is represented by EXPSQ.

Table 5.9 Robustness checks for the dynamic model: Information asymmetry and agency problems

	(1)	(2)
Lag. FCD	2.320***	2.364***
	(0.00)	(0.00)
EXP	1.181**	1.117**
	(0.01)	(0.02)
SIZE	0.157*	0.111
	(0.03)	(0.16)
LEVERAGE	0.059	0.075
	(0.83)	(0.78)
QR	0.003	-0.001
	(0.68)	(0.88)
DEBT/EBITDA	-0.000	-0.001
	(0.72)	(0.677)
OPERATING INCOME/SALES	0.187	-0.037
	(0.75)	(0.95)
CAPITAL EXPENDITURE/SALES	-0.017	-0.032
	(0.25)	(0.11)
INTERNAL OWNERSHIP		0.212
		(0.59)
INSTITUTIONAL OWNERSHIP		0.131
		(0.24)
SALES/ASSETS		0.472**
		(0.05)
		-0.002
		(0.76)
OCF/ASSETS		-0.595
		(0.41)
INTANGIBLE ASSETS/ASSETS	2.591***	
	(0.03)	
AGE	0.003	
	(0.76)	
EMPLOYEE	0.000	
	(0.21)	
GROWTH	0.000	
	(0.87)	
CONSTANT	-4.625***	-3.656***
	(0.00)	(0.00)
N	1550	1550

Note:*, **, *** represents 10%, 5% and 1% significance levels respectively; t statistics are shown in parentheses. In addition to the ratio of sales to total asssets, the sepecification 1 includes two more proxies for agency problems, market-to-book ratio and the ratio of cash flow to total assets. The specification 2 adds proxies for asymmetric information, the firm's age, the number of employees and the growth rate of firms. Data is collected from Wind database.

5.6 Conclusion

This paper employs the static probit regression and dynamic probit regression models to explore the determinants of using foreign currency derivatives among Chinese multinationals listed on the Shenzhen stock exchange and compares different approaches to estimate the dynamic probit model. During the first part, where I analysed what determines derivative usage, the findings show that the degree of foreign sales to firms are positively related to the use of foreign currency derivatives, which suggests that firms with a higher proportion of foreign sales to total sales are more likely to use foreign currency derivatives to minimize their foreign exchange exposure. As with Fauver and Naranjo (2010), larger firms are more likely to use foreign currency derivatives, which suggests that larger firms have a higher ability of risk management and bearing the risk of using derivatives. Also, the increasing growth opportunities available to firms enhances the probability of using foreign currency derivatives, which implies that a good investment environment would motivate the development of a derivatives market.

Considering information asymmetry and agency problems in the specification, I find that they are significantly related to the use of foreign currency derivatives but firms are more likely to use derivatives when there is more information asymmetry and well corporate governance, which is contrary to other literature on US firms. On the one hand, the Chinese financial markets and derivatives markets are not as efficient and transparent as in the U.S and U.K. Due to limited products available to firms and strict requirements of transations in China, firms in China are more likely to use foreign currency derivatives for hedging instead of speculation. Fauver and Naranjo (2010) proposed that US firms are more likely to use derivatives for the abnormal profits and their own interests when firms with higher agency problems. Asymmetic information and agency problems would motivate firms to use foreign currency derivatives to reduce risks and costs of conflict interests. Firms are more likely to use derivatives for hedging foreign exchange risk when there is little agency costs. On the other hand, the proxy for information asymmetry and agency problems used in this paper is relatively simple and thus a more comprehensive index for these problems should be constructed for future research. In the second part of this paper, employing two types of dynamic probit model, we find that the use of foreign currency derivatives in the past period affects the decision to use foreign currency derivatives. Compared with standard random effects models, the Stewart (2006) approach, which allows for endogeneity and implementing the Heckman estimator in a more convenient

way, performs better as the coefficient on the lagged variable has been scaled. Thus, the previous decision to use foreign currency derivatives could signal the decision to use derivatives and risk management strategies during the next period. It would be helpful to predict the financial activities by firms and infer the economic development in future research.

Chapter 6

The dynamic effects of the use of currency derivatives on firm's value: A threshold analysis based on capital structure

6.1 Introduction

With the recent development of the derivatives markets in China, corporations increasingly prefer to use foreign currency derivatives as their risk management tool to hedge against foreign exchange risk in order to create increased firm value. The MM theory illustrates that the firm's value is irrelevant with respect to capital structure in a perfect market, which means that the firm's value would not be affected by risk management strategies in the absence of taxes, transaction costs and agency costs. However, there are frictional costs in the real world and market imperfections are considered in the theoretical literature, such as Mayers and Smith (1982), Smith and Stulz (1985) and Leland (1998), which suggest that hedging strategies could affect shareholder's value by improving tax schedules, reducing agency costs and decreasing the probability of bankruptcy.

Therefore, it is essential to understand what the consequences are from the use of currency derivatives, whilst accounting for high levels of foreign trade being more likey to encourage firms to use derivatives. As investor Warren Buffett has pointed out, derivatives are potentially weapons of mass destruction, such that derivative usage is a double edged sword to the market. This suggests that an efficient derivatives market and specific regulation of the OTC derivatives markets are needed to ensure financial market stability.

As a result, firm value could be positively or negatively affected by derivatives, so it is an important consideration for managers whether to use currency derivatives, as there are implications for the stakeholders of the firm. Also for creditors, the use of derivatives will be a signal of the efficiency of the firms' risk management as firms which are less exposed to risk have a higher ability to pay off debt. In addition shareholders are concerned about whether the firm' stock price is affected by the use of derivatives and whether the use of derivatives leads to executives focusing on risky investments or speculation. Regulators are also eager to assess the role of currency derivatives to ensure the accuracy of accounting and the stability of financial markets.

The previous literature provides mixed results on the effects of derivative usage on firm value. Focusing on US studies, Allayannis and Weston (2001) found there is a positive valuation effect from the use of currency derivatives on the firm, as explained by Barton (2001) in that the use of derivatives could help smooth the cash flow of earnings. Carter, Rogers and Simkins (2006) concentrated on a specific industry and found a hedging premium on the value of firms in the airline industry. Also, the positive relationship between firm value and the use of derivatives was found by Aretz, Bartram and Dufey (2007) and Bartram, Brown and Conrad (2011) who included three types of derivatives and found derivatives could effectively help firms mitigate risks. In contrast to these results, Guay and Kothari (2003) reached a different conclusion, suggesting little evidence of derivatives reducing risk. Fauver and Naranjo (2010) concluded that derivative usage, driven by higher agency costs, is harmful to the firm value through the channel of agency costs and monitoring problems, which was consistent with the findings of Afza and Alam (2011).

The majority of studies have focused on the developed markets but there is little evidence on the emerging markets. As a result, this chapter intends to pay attention to the emerging market in China as Chinese firms have become more likely to use currency derivatives in recent years with the development of their derivatives market. The analysis is concentrated on a sample of 316 firms with ovearseas business in the manufacturing industry over six years from 2012 to 2017. It is important to target the Chinese markets due to their differences with the developed markets and the derivatives market has expanded substantially over recent years. The evidence from the US studies and other developed countries may not reflect the situation in the emerging markests. As the Chinsese stock market is not as efficient as the US, theoretically it is more likely that firms using financial positions would increase their firm value. An analysis of Chinese firms would provide a meaningful supplement to this literature, which could help stakeholders understand the effects of derivatives in different countries.

This chapter contributes to the existing literature through four dimensions. Firstly, this chapter focuses on the effects of using currency derivatives of manufacturing firms in China, providing more evidence to support stakeholders in order to make the best decisions. Moreover, concentrating on a specific industry effectively controls for the heterogeneity caused by industry characteristics, which would be one of the reasons for the mixed results from previous studies. Secondly, we not only focusing on the effect of derivatives in the current period, which indicates a long-term effect, as other literature has done previously but also examining the

influence on the firm from previous lagged derivatives usage. Thirdly, this chapter employs a dynamic panel data model to consider the dynamics of the firm value when estimating the effects of the use of derivatives. The difference GMM model is used to improve the efficiency of estimation by removing time-invariant individual effects and allowing lagged instruments. Fourthly, more importantly, we detect the effect of derivative usage conditional on the threshold effect of the capital structure for the first time. The study shows the non-linear effect of the leverage on the firm value and the use of derivatives exhibits significant effects on the firm with debt levels below the threshold, using Seo and Shin (2016)'s threshold model which allows for the endogeneity of the explanatory variables and transition variables.

To examine the consequences of derivative usage, this chapter intends to answer the following questions. First, we need to identify the effect of derivative usage in both a static and dynamic model which takes into account the dynamic effects of firm value. The use of derivatives has been found to have mixed effects on the firm value. The firm value could increase as the use of derivatives mititgates risks and smooths the volatility of earnings and could decrease due to the existence of information asymmetry and agency problems, based on the study of Fauver and Naranjo (2010) who found firms with large amounts of agency costs have a negative relationship beween the use of derivatives and firm value. Moreover, this study is trying to find out whether derivatives could be a signal for the change in firm value.

Little literature has discussed the lagged derivative usage previously, a factor I consider here. As the derivative usage could indicates the expertise of managers to control risks in the future, the use of derivatives would take effect on the firm value in the following period. Thus, it would be essential to examine the effect of lagged derivative usage, which could help creditors make loans based on the past behaviour of firms. Finally, we examine whether the effect of derivatives depends on the threshold level of the capital structure through the threshold effects of leverage on firm value. MM theory illustrated that as the cost of equity is a linear function of the debt to equity ratio and the cost of equity will increase with a large proportion of debt. Thus, the weighted cost of capital is constant so the firm value is irrelevant to the way of financing. In reality, Cheng et al. (2010) pointed out that there is an optimal capital structure existing in the Chinese market, which indicated that the threshold effects of capital structure on the firm value. We employ the threshold model proposed by Seo and Shin (2016), which allows for endogeneity and the lagged instruments, to explore the non-linear effects of leverage and the effect of derivatives depending on the leverage threshold.

This chapter has six sections, the first section is the introduction, the second section reviews the theoretical and empirical studies of the effect of derivatives usage and the dynamic panel data model. The third section explains the methodology and proposes hypotheses and the fourth section provides data sources and descriptions. The fifth section summarizes and analyses the results and the last section offers some conclusions and policy implications.

6.2 Literature Review

6.2.1 The value effect of foreign currency derivative usage

MM theory suggests that hedging is irrelevant to the shareholder's wealth in a perfect market. However, in the real world, capital markets are imperfect and thus the firm value might be affected by the capital structure of firms due to the existence of taxes, transaction costs, conflicts between managers and shareholders and financial distress, as proposed by Smith and Stulz (1985). A framework to analyse investment and financing policy has been proposed by Froot, Scharfstein, and Stein (1993). Leland (1998) extended the model of risk management by including agency costs and taking the leverage into account and he found that firms might benefit more from hedging in the presence of lower agency costs. Overall, in terms of risk management policies, firms prefer to use hedging to reduce total and systematic risk and specifically they use hedging with derivatives to mitigate against financial frictions to increase the firm's valuey (Nance, Smith Jr and Smithson (1993)). The theoretical literature related to the rationale for hedging provides the foundations for the empirical studies, one stream of the literature focuses on identifying factors that affect the use of derivatives and another stream concerns the effect of hedging on firms. Early empirical studies such as Berkman and Bradbury (1996) provide evidence in line with the implications of the theoretical literature, which indicates that hedging increases the firm value due to the existence of capital market imperfections. Jin and Jorion (2006) illustrated that the use of derivatives is effective in the hedging of risk exposure to commodity price changes, but they did not find that market value responded to derivative usage.

Although the theoretical literature produces similar models for clarifying the rationale for hedging with derivatives through increasing the market value of firms, the results of the empirical studies still remain inconclusive. Studies working on the relationship between hedging and firm value have produced mixed results. Aretz and Bartram (2010) concluded that the mixed empirical results from estimating the value effects of derivative usage are caused by

endogeneity and the limitations of the model specifications. Most of the empirical studies found a positive relationship between hedging and shareholder value by proxying financial distress, using the long-term debt ratio, but the type of proxy variable used influences the conclusions these studies reach.

With a sample of the the Fortune 500 firms, Barton (2001) explored hedging as a tool for firms to reduce the volatility of cash flows so as to stabilise earnings. Allayannis and Weston (2001) examined U.S non-financial firms facing significant exchange rate exposure to compare the differences of the firms' market value between hedgers and non-hedgers whilst controlling for firm specific characteristics. The results showed that the value-effect is economically significant for the firm using foreign currency derivatives to alleviate foreign exchange exposure. Their results, which are consistent with the risk management theories, show a rise of 4.87% in the firm value resulting from the use of foreign currency derivatives. Fatemi and Luft (2002) compared the costs and benefits of risk management strategies, which is one of the most important tools to maximise shareholder's wealth for the firm. To increase debt capacity is one of the drivers of hedging, as suggested by Graham and Rogers (2002). They find a negative correlation between hedging and tax liabilities including the assumption of the convexity of the tax function so that the firm value might be affected by higher leverage.

Adam and Fernando (2006) concluded that the net value of the derivative transactions is not zero in a study examining gold mining firms, which violates the previous MM theory. Moreover, Carter, Rogers and Simkins (2006) estimated the firm value effect on U.S. non-financial firms focusing on a specific industry, which was the U.S. airline industry. They found a positive relationship between hedging and the firm's value implying a value-increasing effect in the airline industry which is greater than what Allayannis and Weston (2001) found. Aretz, Bartram and Dufey (2007) discovered that corporate hedging increased shareholder value, which was supported by firm-level empirical evidence and they illustrated that to increase the market value of firms is to reduce the variance of the cash flow by using derivatives, which mitigates the transaction costs and taxes in the real world. In addition, Lin and Smith (2007) showed that hedging influenced financing decisions, depending on the opportunities for investment projects.

When investigating the effect of hedging on the market value of UK firms, Belghitar, Clark and Judge (2008) separated interest rate derivatives from foreign currency derivatives and

presented a stronger result than previous studies on U.S non-financial firms, due to the difference in bankruptcy costs between the UK and US, leading to lower financial distress costs in the UK. Clark and Judge (2009) compared differences in the value-effect among various techniques to mitigate risk, such as foreign debt, foreign currency derivatives and interest rate derivatives and it is only when foreign currency derivatives and interest rate derivatives have been used that corporations benefited through the firm value increasing, but this was not the case when foreign debt was used.

Based on a large dataset across 47 countries, Bartram, Brown and Conrad (2011) found a significantly positive effect on reducing risks when using derivatives, including three types of derivatives. In addition, they estimated the effect of the derivative usage on the variance of the cash flow and stock return respectively. They found a positive value-effect which was greater during economic downturns, which implies that firms prefer to hedge downside risk. Gómez-González, León Rincón and Leiton Rodríguez (2012) investigated the impact of the risk management strategies and the use of derivatives on the market value of the firm, using non-financial firms in Columbia's most liquid forward market. They found hedging with derivatives leads to an increase in Tobin's q, which is used to proxy the market value of firms. Bessler, Conlon and Huan (2019) employed meta-analysis, which focused on reviewing evidence from previous studies, to explore the value-effect caused by derivative usage and they found a greater value-effect is related to the use of foreign currency derivatives than the effect of using commodity and interest-rate derivatives.

Doidge, Karolyi and Stulz (2007) and Allayannis, Lel and Miller (2012) payed particular attention to the importance of corporate governance on the firm's use of derivatives and the latter study found that different states of governance lead to different degrees of value enhancement by hedging. A firm with strong corporate governance has a significantly higher hedging premium, even when the firms located in a country with strong external governance have poor internal governance. Moreover, there is no significant effect on firms lacking both internal and external governance.

However, there are some studies contradicting the traditional rationale for hedging with derivatives to obtain the value premium. Guay and Kothari (2003) compared the benefits and costs of derivative usage and identify a different result to that found by the previous literature, which suggests derivative usage is of little importance to the firm-level risk exposure. After

examining 119 U.S. oil and gas firms, Jin and Jorion (2006) found no significant value-premium effect from hedging in this specific industry, concluding that industry characteristics need to be considered in future studies. Fauver and Naranjo (2010) found a negative relationship between the firm's market value and derivatives usage, on average a -8.4% value effect, of firms with more managerial problems or agency problems. Afza and Alam (2011) obtained similar results to those of Fauver and Naranjo (2010), indicating that firms have a higher propensity to hedge when encountering fewer managerial holdings.

6.2.2 Review of dynamic panel models and threshold effects models

Concentrating on the panel data approach, Hansen (1999) employed the least squares estimation and fixed-effects transformation to estimate a threshold effects static model with a panel data technique and proposed the asymptotic theory to construct confidence intervals for the parameters, which was applied to analyse the response of investment decisions to different degrees of financial constraints. Hansen's (1999) technique is the cornerstone of the threshold effects model but is limited to the static status and strictly exogeneous requirements for the explanatory variables to obtain consistent estimates. Furthermore, Hansen (2000) provided an approach which is different from the standard distributions to support the statistical inference for threshold estimation.

Based on a static model, Arellano and Bond (1991) extended the dynamic model for unbalanced panel data and improved a generalised method of moments (GMM) estimator based on the IV estimators initially proposed by Anderson and Hsiao (1981). But Arellano and Bond (1991) also indicated that the endogenous explanatory variables would be likely to hamper the consistency of the estimators. Caner and Hansen (2004) obtained consistent estimates by employing the two-stage least squares method to estimate the threshold effects and followed Hansen (2000)'s asymptotic distribution to analyse the results. The majority of theoretical studies have focused on the linear relationship and the consistency of estimators in the dynamic model by using GMM methods such as Arellano and Bond (1991), Alvarez and Arellano (2003) and Hsiao and Zhang (2015), particularly in a large N or T case and when both are large.

Hansen (1999) applied his model to non-dynamic data to explore threshold effects on economic growth but the limitation of this model is that the endogenous regressors would lead to inconsistent estimators. The model used by Hansen (1999, 2000) and Seo and Linton (2007)

with threshold effects needs strict assumptions for the exogeneous explanatory variables and threshold variables. The latter study also improved the application of standard techniques for statistical analysis. Caner and Hansen (2004) relaxed the assumption of exogeneity for regressors as their model only required the threshold variable to be exogeneous and allowed endogeneity of other explanatory variables.

Wang (2015) created a program in Stata to estimate the fixed-effects threshold models proposed by Hansen (1999) but found the model is not sufficient to identify the nonlinear effect, thus he extended the model to include more threshold variables. Seo and Shin (2016) extended the threshold effects to dynamic panel models with the same data as used in Hansen (1999) for comparison and simultaneously filled the gap regarding the existence of endogeneity of the regressors and the threshold variable in the dynamic threshold model. This model not only allows the endogeneity of normal regressors but also of the transition variable. Seo, Kim and Kim (2019) developed the program for Stata to implement the threshold model that allows endogeneity of all regressors which can be more easily applied to empirical research.

Threshold effects models have been applied to many empirical studies, such as Khan and Ssnhadji (2001), Adam and Bevan (2005) and Kremer et al. (2013). These studies concentrated on discovering the relationship between inflation and economic growth and Kremer et al. (2013) employed the dynamic model to study the threshold effects of inflation on long-term economic growth also and they combined the model of Hansen (1999) with the instrumental variable estimation proposed by Caner and Hansen (2004) to solve the endogeneity bias existing in the previous literature. Furthermore, Girma (2005) adopted the threshold techniques to explore the effects of foreign direct investments on productivity growth depending on the threshold of absorptive capacity. A threshold level of financial depth was proposed by Arcand et al. (2015) as they used the threshold model to find the vanishing effects of finance on economic growth based on a certain level of financing. Thus, threshold techniques could be useful for economic and financial empirical studies. As Smith and Stulz (1985) have mentioned the firm value would be affected by derivatives usage in the imperfect market due to the agency costs or other factors, it would therefore be interesting to explore whether the effects of derivatives usage on firm value are dependent on the threshold of the firm specific characteristics.

6.3 Hypotheses and methodology

6.3.1 Static and dynamic panel data models

Manufacturing firms are easily exposed to foreign exchange risk as they have high levels of foreign business, which motivates the use of derivatives to hedge. The derivatives take the role of controlling for risks that firms would face to ensure the earings are smoothed and less volatile. Thus, firm value will be increased with the use of derivatieves, as found by Allayannis and Weston (2001) who found the use of currency derivatives is useful for mitigating risk exposure and the firm value increases based on US studies. As Fauver and Naranjo (2010) have illustrated, agency costs and information asymmetry could lead to a negative effect on the firm when using derivatives, so I also add controls for these and expect a negative relationship between agency problems and firm value. I put forward the first hypothesis, which is shown as below,

Hypothesis 1: The effect of using derivatives on the firm value is positive in the static situation and after controlling for the dyamic effects of firm value. In addition the firms's value decreases with the existence of information asymmetry and higher agency costs.

This chapter employs a fixed effects model to explore the effect of using currency derivatives on the firm's value and this will control for the heterogeneity during the estimation. By considering the individual effects in panel data, the fixed-effects model performs better than the pooled OLS model and provides consistent estimators. The basic fixed effects model includes the individual effects as u_i, which are correlated with the explanatory variables, the model can be described as,

$$y_{it} = \beta x_{it} + v_{it} \tag{6.1}$$

$$where\ v_{it} = u_i + \varepsilon_{it} \tag{6.2}$$

v_{it} represents the composite error term, which includes the individual effects and the error term. y_{it} is the dependent variable and x_{it} represent the set of explanatory variable we are interested in. Hausman and Taylor (1981) developed an efficient estimator by employing the generalised least squares method in the fixed effects model. Based on the basic model, we construct the specification used in this study, as follows:

$$FV_{it} = \beta_1 DER_{it} + \beta_2 EXP_{it} + \beta_3 INFORMATION_{it} + \beta_4 AGENCY_{it} + \delta CONTROL_{it} + u_i + \varepsilon_{it} \quad (6.3)$$
$$i = 1,2,3 \dots N\ , t = 2,3,4 \dots T$$

FV_{it} refers to the current and past values of the firm. DER_{it} represents the derivative usage of the firm and EXP_{it} represents the level of foreign business of the firm. The information asymmetry and agency problems are represented by $INFORMATION_{it}$ and $AGENCY_{it}$. $CONTROL_{it}$ refers to the control variables, which includes the firm's characteristics, such as size, liquidity, profitability and growth opportunities.

Many studies have focused on examining the value effect of derivative usage of firms in a static panel model, such as Allayannis and Weston (2001), while few studies explore the impact of derivative usage from a dynamic perspective. Dynamic panel models, such as the Arellano-Bond, Arellano-Bover and Blundell-Bond estimation, are popular in the area of financial economic empirical studies. As the dynamic panel model is more complicated than the static one, it tends to be more likely to generate inefficient and biased estimators. Roberts and Whited (2013) proposed that the main issue of econometrics applied to empirical corporate finance studies is the endogeneity problem as it is difficult to use strictly exogeneous variables, which lead to biased estimators that make the analysis unreliable.

The GMM approach is used for the dynamic panel model as the dynamic estimation from simply using an OLS or fixed effects model would cause an endogeneity problem and therefore biased estimators. Based on the Anderson and Hsiao (1981) estimator, Arellano and Bond (1991) made an extension on their specification containing exogeneous variables by using the generalised method of moments, known as (GMM). They proposed a first-differenced GMM (FD-GMM) method with a strict exogeneity assumption and treated the lagged explanatory variables as instruments. The dynamic panel model can be constructed as in equation (4), which is the same as the fixed-effects model, by including individual effects but this model comprises the lagged dependent variables as further explanatory variable in this specification.

$$y_{it} = \alpha y_{it-1} + \beta x_{it} + v_{it} \quad (6.4)$$

As for the existence of heterogeneity in the model, the way to eliminate the individual effects is to take a differenced transformation of the original equation. Thus, the specification is shown as follows:

$$\Delta y_{it} = \beta_0 \Delta y_{it-1} + \beta_1 \Delta x_{it} + \Delta v_{it} \tag{6.5}$$

$$\Delta v_{it} = \Delta \varepsilon_{it} \tag{6.6}$$

As the approach uses a differenced transformation for the specification, the individual effects are removed and then the differenced composite error term is the differenced error term. In order to obtain the GMM estimator, the lagged dependent variable and explanatory variables are treated as instruments. As a result, the orthogonality moment conditions are described as:

$$E(Z_i \Delta v_{it}) = 0 \tag{6.7}$$

Using GMM estimation, Z_i is a set of instruments including the exogenous variables, the lagged dependent variables and explanatory variables. FD-GMM includes two types of models for treating the error, the one-step and two-step approaches. The one-step GMM is used when the error is not serially correlated otherwise the two-step differenced GMM is used to obtain the estimator. However, Roodman (2009) mentioned that the two-step differenced GMM would lead to a biased estimator in finite samples although Windmeijer (2005) made a correction for this. Thus, we employ the one-step difference GMM method to identify the effect of derivative usage on the firm including the impact of the past firm value. As firm value tends to suffere from inertia, it is essential to figure out whether the current firm value can be explained by the firm value from one period before when examining the value effect of derivative usage. As a result, the expected firm value is conditional on the past firm value and the effect of foreign currency derivative usage. This study intends to identify whether the current firm value is dependent on past observations and estimates the effects with the use of foreign currency derivatives. As a result, the specification is as follows:

$$\begin{aligned} FV_{it} = \beta_0 FV_{it-1} + \beta_1 DER_{it} + \beta_2 EXP_{it} + \beta_3 INFORMATION_{it} + \beta_4 AGENCY_{it} \\ + \delta CONTROL_{it} + u_i + \varepsilon_{it} \\ i = 1,2,3 \dots N \, , t = 2,3,4 \dots T \end{aligned} \tag{6.8}$$

In the specification(6.8), FV_{it-1} refers to the past value of the firm. We are also interested in the consequences of lagged derivatives uage, which could be a signal of firm value increasing or decreasing for shareholders and creditors when making financial decisions. As the use of

derivatives such as the forward contract could limit foreign exchange risks in the future, shareholders would expect an increase in the firm value and creditors would consider the firm was less liable to experience bankruptcy and would have a credible ability to payoff debt. The second hypothesis is proposed as following,

Hypothesis 2: The use of foreign currency derivatives in the current period positively affects the firm value in the next period. Thus, the use of derivatives from past periods could be a signal for an increasing firm value.

As a result, we need to add the lagged derivatives usage to the specification in order to identify the effect of derivatives usage from past periods on the firm' value. The specification is described as following,

$$FV_{it} = \beta_0 FV_{it-1} + \beta_1 DER_{it} + \beta_2 DER_{it-1} + \beta_3 EXP_{it} + \beta_4 INFORMATION_{it} + \beta_5 AGENCY_{it} + \delta CONTROL_{it} + u_i + \varepsilon_{it} \quad (6.9)$$
$$i = 1,2,3 \dots N\,, t = 3,4,5 \dots T$$

DER_{it} and DER_{it-1} repesent the derivatives indicator for time t and $t-1$ respectively. As the lagged variables could also be used as instruments when using GMM, two important tests need to be implemented after the GMM estimation due to the problem of serial correlation in the dynamic model and the potential for overidentification which could lead to a reduction in the strength of the instruments. The serial correlation test for AR (1) would show a significant correlation as the lagged variable is included in the specification. There would be no serial correlation if the test results of the AR (2) test do not reject the null hypothesis. If the Hansen J test does not reject the null hypothesis representing the validity of the instruments, we need to follow Wintoki et al. (2012) by using the curtailing of the lag and collapsing method, which reduce the problems with instruments proliferation, using the standard instruments instead of GMM style of instruments, to solve the problem by reducing the weakly instrumental variables.

6.3.2 Threshold effects models

As the study by Black (1976) has proposed, financial leverage can help explain the asymmetric relationship between stock returns and volatility, suggesting it is a good threshold variable when analysing the financial sector. Overal the level of debt is one of the most essential factors

to the firm value and so this chapter considers the leverage as the threshold variable in the model. Cooper (1977) illustrated that capital flows has the optimal equilibrium instead of continuous flows under different exchange rate regimes. Firms should be moderate in investing foreign business and consider strategies to reduce the exchange risk combining with the assets portfolios of the firm. Meanwhile, as there exists a variety of costs in real markets, too much debt could undermine attempts by the firm to maximize the firm's value, so the optimal capital structure is an important determinant of the firm's value, as supported by Cheng et al. (2010). We therefore obtain the third hypothesis, shown as follows,

Hypotheis 3: There is a threshold level of the debt ratio for the firm and a non-linear effect of the leverage on the firm value. It is expected that when the leverage exceeds the threshold level the increasing leverage is harmful to the shareholder's value.

To estimate the non-linear effect of the leverage on the firm value, this study first employs the standard methods, including the ordinary least square method and the gerneralised method of moments to find out whether the firm value has a non-linear relationship with the level of debt. Moerover, Hansen's threshold model, implemented by Wang (2015), is employed to detect the threshold level of the leverage in a static model.

Considering the expectation of the leverage threshold effects on the firm value, I intend to analyse whether the affect of deivative usage on the firm value is conditional on the leverage effects. As firms with high debt levels prefer stable investments and earnings to enable them to payoff their debt, the use of derivatives is less important compared to firms with lower debt levels. Because firms with lower debt levels prefer riskier investments with higher returns, the use of derivatives could enable them to better control for the risks, which has a positive effect on the firm's value. I put forward the fourth hypothesis,

Hypothesis 4: The firm valuation effect of derivatives is dependent on the threshold level of the capital structure due to the threshold effects of leverage on firm value, which is estimated using a threshold dynamic panel model.

As Seo and Shin (2016) have suggested, the basic threshold effects model could be described as

$$y_{it} = (1, x'_{it})\rho_l 1\{q_{it} \leq \gamma\} + (1, x'_{it})\rho_h 1\{q_{it} > \gamma\} + \eta_i + e_{it} \quad (6.10)$$
$$i = 1,2,3 \dots N; \;\; t = 1,2,3 \dots T$$

y_{it} is the dependent variable while x'_{it} refering to a vector of $m_1 \times 1$ explanatory variables and control variables that we are interested in and may contain the lagged dependent variable. q_{it} and γ represent the transition variable and the threshold level respectively while $1\{\cdot\}$ is an indicator function. ρ_l indicates the estimated coefficients on the regressors for the lower regime and ρ_h for the upper regime. η_i is the time-invariant individual effect of the firm and e_{it} is the error term. The model proposed by Seo and Shin (2016) relaxed the exogenous assumption that the error term is uncorrelated with all of the regressors including the transition variable, which enables the endogeneity of $x_{it}$and q_{it} in the specification. Seo and Shin (2016) proposed FD-GMM estimation for the threshold model that extended the static threshold approach of Hansen (1999) by employing the Arellano Bond (1991) estimator to the dynamic panel threshold model, which enables the examination of the dynamic panel based threshold effects. The first step is to remove the unobserved individual effects η_i , which would lead to a biased estimator. This follows Arellano and Bond (1991), such that the first-difference transformation is made for equation(11) as follows:

$$\Delta y_{it} = \alpha \Delta x'_{it} + \mu' X'_{it}\, 1_{it}(\gamma) + \Delta e_{it} \quad (6.11)$$

where $\mu = \rho_l - \rho_h$, $X_{it} = \begin{pmatrix} (1, x'_{it}) \\ (1, x'_{it-1}) \end{pmatrix}$, $1_{it}(\gamma) = \begin{pmatrix} 1\{q_{it} \leq \gamma\} \\ -1\{q_{it} \leq \gamma\} \end{pmatrix}$, where Δ represents the first-difference operator and $\pi = (\alpha, \mu, \gamma)$. Seo and Shin (2016) mentioned that a biased estimator would be generated if the transformation is estimated by OLS directly as the transformed regressors may be correlated with the differenced error term. To solve the bias problem, Seo and Shin (2016) exploited instrumental variables which may include exogeneous variables, lagged x_{it} and q_{it} , and the lagged dependent variable. Thus, k dimensional instrumental variables are constructed as $\left(z_{it_0}, \dots, z_{iT}\right)$ for $2 < t_0 \leq T$ and

$$E(\Delta e_{it} | z_{it}) = 0 \,, \; t = \; t_0, \dots T \quad (6.12)$$

Thus, given the sample moment conditions, $\hat{\gamma}$ could be measured by an interval and Seo and Shin (2016) chose $\hat{\gamma}$ be the minimum value of the interval. For a given γ, $\hat{\alpha}$, $\hat{\mu}$ it can be evaluated by the function of $\hat{\alpha}(\gamma)$ and $\hat{\mu}(\gamma)$. As a result, a set of estimated coefficients $\hat{\pi} =$

$(\hat{\alpha}, \hat{\mu}, \hat{\gamma})$ can be obtained by generalized method of moments. Combining the threshold model dynamic panel approach proposed by Seo and Shin (2016) with conventional corporate finance theory, the specification can be represented as follows:

$$FV_{it} = (1, x'_{it})\rho_l 1\{LEVERAGE_{it} \leq \gamma\} + (1, x'_{it})\rho_h 1\{LEVERAGE_{it} > \gamma\} + \eta_i + e_{it} \quad (6.13)$$

FV_{it} is the dependent variable, and the lagged variable FV_{it-1} is included in x_{it}, which also contains the control variables and the main explanatory variables which are derivatives usage, the level of exports, the agency problem and the information asymmetry. γ represents the threshold level of the transition variable. The lower regime represents the estimation when the transition variable is below the threshold level and when the transition variable is greater than the threshold level it refers to the upper regime. Additionally, the lagged explanatory variables are treated as instruments in the estimation. Based on hypothsis 3 and 4, this study considers the financing leverage as the transition variable to examine the dynamic effect of derivatives usage on the firm value depending on the capital structure of the firm.

6.4 Data description

This chapter examines the effects of foreign currency derivative usage on the firm value, thus it is essential to find a proxy to measure the firm value, which is the dependent variable in this specification. The dependent variable is the market value of multinational corporations, measured by Tobin's Q in this study. Tobin's Q was initially proposed by Tobin and Brainard (1976) and was applied to macroeconomic studies while in recent years Tobin's Q has been considered as an indicator of firm's performance (Wenefelt and Montogemer (1988)). Some studies use cash flow data or stock return data to represent the market value of firms, but Tobin's Q is more comprehensively used than other proxies. Allayannis and Weston (2001), Carter, Rogers, and Simkins (2006) and Bartram, Brown and Fehle (2009) provided effective evidence from using Tobin's Q in their studies. Following Fauver and Naranjo (2010), this study calculates Tobin's Q of the firm for each year by using the market value of equity plus the book value of assets minus the book value of equity, which is divided by the book value of assets. The majority of studies choose Tobin's Q to indicate the firm's market value, such as Bartram, Brown and Conrad (2011) and Luo and Wang (2018). Meanwhile, although there are three approaches to calculate Tobin's Q, proposed by Allayannis and Weston (2001), Chung

and Pruitt (1994) and Lindenberg and Ross (1981), Allaynannis (2012) found that there are little impact on exaiming the effect of currency derivatives on firm value by employing different measures for constructing Tobin's Q, other explanatory variables are described in detail in the previous chapter 5 as this chapter uses the same measurement for the firm characteristics, agency costs and information asymmetry. Fauver and Naranjo (2010) found evidence of a negative association between the firm's market value and the use of derivative products in firms experiencing higher agency costs and severe asymmetric information problems. Generally I would expect that the firm with good corportate governance would benefit from derivative usage. As the majority of studies have used, such as Allayannis and Weston (2001), Bartram (2011) and Allaynannis (2012), this chapter includes the level of trade, firm size, liquidity, capital structure, bankruptcy costs and growth opportunities as control variables in the model.

6.5 Empirical analysis

6.5.1 Descriptive statistics

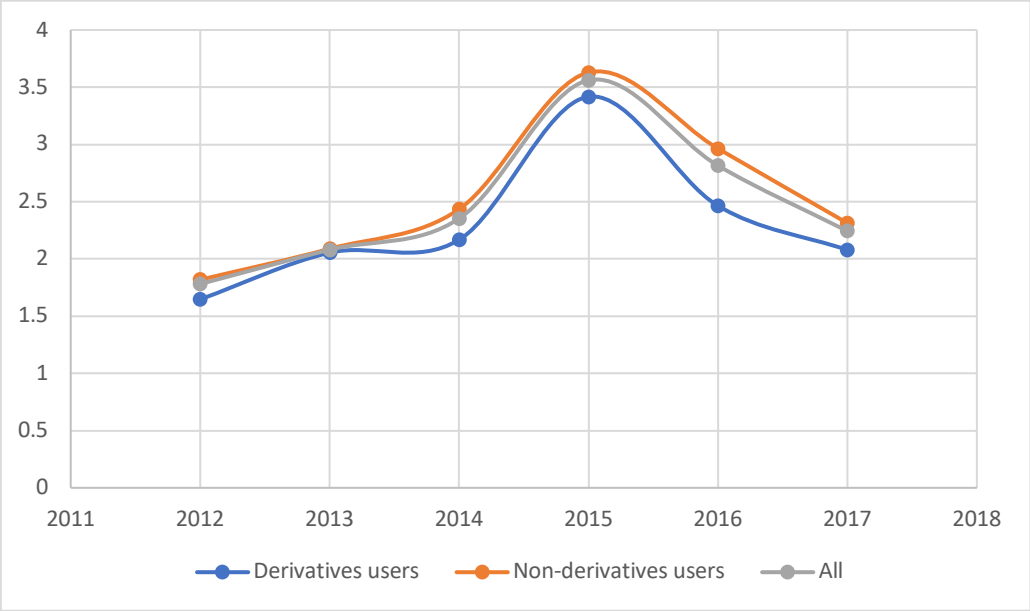
As described in section 4, we use Tobin's Q to represent the firm value and the mean of 1896 observations is 2.47. Tobin's Q is equal to 1 when the enterprise value is euivalent to the replacement costs of the firm. The firm is overvalued if Tobin's Q is greater than 1 otherwise the firm is undervalued. Higher values of Tobin's Q motivate firms to pursue more investments as their market value is over-estimated in the financial market. It can be seen from Table 6.1 that the standard deviation of the firm value is around 1.51 and Tobin's Q ranges from about 0.71 to 14.93. Figure 6.1 shows the trend in Tobin's q over the sample period as measured by the average of the firm value for each year. Focusing on all firms, starting from 2012 to 2015, the average of the firm value experienced an increase from 1.78 to 3.56. The peak is located in the year 2015 and Tobin's Q suffered a slump afterwards, which could reflect the impact of the Chineses stock market decline in 2015. It could be observed from the figure that firms with derivatives and without derivatives have a similar trend in terms of Tobin's Q over the period but the average value of the firm with derivatives is always lower than for firms without derivatives.

Table 6.1 Preliminary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Tobin's Q	1,896	2.472	1.513	0.705	14.926

(source: Wind database)

Figure 6.1 Comparisons of Firm value between derivative users and non-derivative users



(source: Data about the use of foreign currency derivatives is hand-collected from annual reports of firms by searching keywords, such as forward, futures, foreign currency derivatives.)

To provide an insight from the effect of capital stucture on the firm value, we simply divided firms into two groups by the mean value of leverage(0.243). Table 6.2 summarizes the average value of the main variables and control variables for observations whose leverage is lower than 0.243 and mean value for firms whose leverage is greater than the mean leverage. There are 1055 oveservations with a leverage below the mean and 841 obesrevations in the upper leverage group. We observed that average Tobin's Q for firms with the lower leverage is greater than that for firms with the higher leverage, which suggests that the firm value will not increase at high levels of debt. From a simple t-test of which the null hypothese is that the difference between the mean value in the low leverage and high leverage groups is equal to zero, the result shows that the firm's value is significantly different to zero.

Meanwhile, the size, quick ratio and the ratio of operating income to total sales for firms with lower leverage is signigicantly different from those proxies for firms with higher leverage based on the results from t-test. The indicators for agency costs do not appear to have significant differences between the two groups but the information asymmetry is different at the 5% significance level. As seen from the tables, firms with higher leverage exhibit higher asset opaqueness than firms with lower leverage. Furthermore, to have a general view of using currency derivatives in the divided groups, we employ Wilcoxon rank-sum (Mann-Whitney) test of which results are summarized in Table 6.3. In general, the majority of observations do

not use currency derivatives in the low leverage group and high leverage group, with 71.6% and 72.5% respectively. It shows that around 28.4% of all obseravtions in the lower leverage group use currency derivatives, which is slightly higher than the proportion(27.5%) of those using derivatives in upper leverage group.

Focusing on the similarity between both groups, the firm value is significantly different between derivative users and non-derivative users. The resuls are the same for firm size, quick ratio, the export level and the ratio of capital expenditures to sales. Turning our attention to the group with lower leverage, it shows that the leverage and the profitability is significantly different between derivative and non-derivative users. The degree of information transparency, measured by the ratio of intangible assets to total assets, exhibits an evident difference at the10% siginificance level. There is a significant distinction in agency costs between users and non-users by proxies for agency costs, comprising the internal and external ownership concentration and the ratio of sales to assets. In the upper leverage group, I find that the ratio of institutional ownership and sales to assets shows a clear difference between derivative users and non-derivative users.

Table 6.2 The difference between low and high leverage groups

	Low leverage	High leverage	T-test
TOBIN'S Q	2.736	2.141	8.674***
	(1.62)	(1.29)	(0.00)
FCD	0.284	0.275	0.467
	(0.45)	(0.45)	(0.64)
EXP	0.346	0.333	1.236
	(0.23)	(0.22)	(0.22)
SIZE	14.883	15.515	-13.444***
	(0.86)	(1.19)	(0.00)
QR	2.493	1.224	7.524***
	(4.40)	(2.40)	(0.00)
LEVERAGE	0.092	0.432	-65.793***
	(0.08)	(0.14)	(0.00)
DEBT/EBITDA	2.373	3.842	-0.787
	(28.15)	(51.75)	(0.43)
CAPITAL EXPENDITURE/SALES	2.078	2.078	-0.001
	(6.64)	(6.70)	(0.99)
OPERATING INCOME/SALES	0.065	0.021	6.930***
	(0.13)	(0.14)	(0.00)
INTERNAL OWNERSHIP	0.332	0.323	1.287
	(0.13)	(0.15)	(0.20)
INSTITUTIONAL OWNERSHIP	0.358	0.370	-1.098
	(0.24)	(0.22)	(0.27)
SALES/ASSETS	0.616	0.639	-1.604
	(0.29)	(0.34)	(0.11)
INTANGIBLE ASSETS/ASSETS	0.047	0.051	-2.310**
	(0.04)	(0.06)	(0.02)
N	1055	841	

*,**,*** represent significance levels of 10%, 5% and 1%, standard deviation in the brackets in first two columns, and the third column is for t-test results and p-value in parentheness.

Table 6.3 Wilcoxon test for derivatives and non-derivatives users within group

	Low leverage	High Leverage
FCD USERS	300(28.4%)	231(27.5%)
NON-FCD USERS	755(71.6%)	610(72.5%)
TOBIN'S Q	2.020**	1.699*
	(0.04)	(0.09)
EXP	-10.241***	-8.621***
	(0.00)	(0.00)
QR	3.637***	-2.095**
	(0.00)	(0.04)
SIZE	-6.150***	-4.791***
	(0.00)	(0.00)
LEVERAGE	-1.684*	-0.681
	(0.09)	0.50
DEBT/EBITDA	0.772	1.597
	0.44	0.11
OPERATING INCOME/SALES	-2.797**	-0.583
	(0.01)	0.56
CAPITAL EXPENDITURE/SALES	5.464***	4.268***
	(0.00)	(0.00)
INTANGIBLE ASSETS/ASSETS	-1.787*	0.686
	(0.07)	(0.49)
INTERNAL OWNERSHIP	-4.500***	-1.310
	(0.00)	(0.19)
INSTITUTIONAL OWNERSHIP	-4.783***	-4.354***
	(0.00)	(0.00)
SALES/ASSETS	-7.692***	-6.601***
	(0.00)	(0.00)
N	1055	841

*,**,*** represent significance levels of 10%, 5% and 1% respectively, p-values are in parentheness

6.5.2 The static and dynamic effects of derivative usage on firm' value

To identify the effects of the use of foreign currency derivatives on the firm value, we use Tobin's Q to represent the market value of a firm and a dummy variable for derivatives usage, which is equal to 1 if the firm disclosed the use of foreign currency derivatives in the annual report. In addition, we are interested in the value effect from the agency problems and information transparency since it is expected that the use of derivatives could affect firm value through those costs. Ownership concentration is used as a measure of agency problems, which are estimated as the proportion of the largest shareholder, the share proportion of the institutions, and the ratio of sales to total assets to measure the effectiveness of managers to invest in productive investments. The ratio of intangible assets to total assets is a proxy for the asset opaqueness, so estimating the information asymmetry in the market.

Interaction terms with dummy variables are also used to examine whether the use of derivarives is kind of mechanism to affect firm value. To control for the firm's individual effects, we employ a fixed effects model to examine the relationship between the firm value and the firm's decision to use derivatives. Table 6.4 provides results for three specifications. The specification (1) includes our main variables and control variables for the firms' characteristics while specification (2) and specification (3) adds the derivative interation terms with information asymmetry and agency proxies respectively.

Compared with the results of the US study from Allayannis and Weston (2001) who showed that derivative usage exhibits a significant value premium, the results from this table do not show a significant firm value effect from using currency derivatives by manufacturing firms in China. However, consistent with Allayannis and Weston (2001) and Lang and Stulz (1994), the size of the firm is negatively linked with the firm value at the 5% significance level. The degree of exports, as measured by the ratio of foreign business to total sales, has a significantly positive correlatation with the firm value across three specifications. The firm value is negatively correlated with firm's liquidiy but increases with the ratio of debt to earnings before interest, taxes, depreciation and amortization. The Tobin's Q increases with the rise in profitbability and more growth opportuinites for the firm, being measured by the ratio of operating income to total sales and the ratio of capital expenditures to total sales.

Focusing on the main variables, we find that insider ownership is negatively affecting Tobin's Q, which suggests that the firm value will decrease with more concentrated internal ownership. It can also be seen from Table 6.4 that the the proportion of shares owned by institutional investors has a valuation premium on the firm. That is to say, a diversified ownership structure is positively asscociated with the firm market value. Both the ratio of sales to assets and the interactive term with the use of derivatives do not show a significane effect on firm value. Moving to the proxy for information asymmetry, we find that the coefficients on the ratio of intangible assets to total assets are not significant across all the specfications but the coefficient on the interactive terms is negatively related to the firm market value in the second specification.

In addition to the main measures for agency costs and information asymmetry, this study has followed Javakhadze et al.(2014) by including the ratio of market to book and the ratio of cash flow to total assets, which has also been employed by Fauver and Narajo (2010) and Bartram, Brown and Cornad (2011). Table 6.5 summarizes the results from comparing firms that use foreign currency derivatives and those that don't. Firms with or without the foreign currency derivatives experience a significant and positive effect when they have a diversified ownership structure. The more concentrated the internal ownership is, the less firm value is obtained. For the value of firms whouse foreign currency derivatives, they are negatively affected by the ratio of market-to-book. The proxies for asymmetric information do not have significant differences between the sub-sample of firms thatuse foreign currency derivatives in the static model.

Table 6.4 Static model: fixed effects

	(1)	(2)	(3)
FCD	-0.002	0.057	0.053
	(-0.05)	(1.29)	(0.63)
EXP	0.053**	0.054**	0.053**
	(2.28)	(2.31)	(2.30)
SIZE	-0.071**	-0.067**	-0.071**
	(-2.37)	(-2.32)	(-2.36)
QR	-0.004*	-0.004*	-0.004*
	(-1.68)	(-1.66)	(-1.71)
LEVERAGE	0.117	0.135	0.124
	(0.95)	(1.08)	(1.02)
DEBT/EBITDA	0.0002**	0.0002**	0.0002**
	(2.22)	(2.29)	(2.11)
CAPITAL EXPENDITURE/SALES	0.012***	0.012***	0.012***
	(3.73)	(3.82)	(3.72)
OPERATING INCOME/SALES	0.615***	0.636***	0.612***
	(2.92)	(2.99)	(2.90)
INTERNAL OWNERSHIP	-1.049***	-1.066***	-1.045***
	(-4.28)	(-4.32)	(-4.28)
INSTITUTIONAL OWNERSHIP	0.593***	0.594***	0.592***
	(6.80)	(6.87)	(6.77)
SALES/ASSETS	0.004	-0.005	0.029
	(0.05)	(-0.06)	(0.34)
INTANGIBLE ASSETS/ASSETS	-0.484	0.332	-0.536
	(-1.43)	(0.78)	(-1.55)
DER*IATA		-1.220**	
		(-2.44)	
DER*SATA			-0.082
			(-0.77)
CONSTANT	1.993***	1.904***	1.984***
	(3.96)	(3.92)	(3.94)
Rho	0.597	0.601	0.598
Fixed effects	√	√	√
N	1896	1896	1896

*,**,*** represent significance levels of 10%, 5% and 1% respectively, t statistics are in parentheness, Rho represents the fraction of variance due to individual effects.

Table 6.5 Static model: Comparions between FCD users and non-FCD users

	(1)		(2)		(3)		(4)		(5)	
	Users	Non-users	Users	Non-users	Users	Non-users	Users	Non-users	Users	Non-users
EXP	-0.190**	0.084***	-0.188**	0.078***	-0.201***	0.077**	-0.192**	0.0734**	-0.177**	0.070**
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.03)
SIZE	-0.045	0.018	-0.045	0.012	-0.195**	-0.035	-0.220***	-0.036	-0.231**	-0.052
	(0.58)	(0.57)	(0.62)	(0.73)	(0.01)	(0.32)	(0.01)	(0.32)	(0.01)	(0.17)
QR	0.000	-0.008	0.000	-0.008	-0.003**	-0.005	-0.003*	-0.005	-0.003	-0.004
	(0.78)	(0.53)	(0.90)	(0.55)	(0.02)	(0.63)	(0.037)	(0.62)	(0.07)	(0.69)
LEVERAGE	-0.395	0.291*	-0.291	0.274	-0.383**	0.272**	-0.314	0.295**	-0.196	0.278
	(0.12)	(0.05)	(0.20)	(0.07)	(0.020)	(0.05)	(0.13)	(0.04)	(0.36)	(0.06)
DEBT/EBITDA	0.000	-0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.28)	(0.98)	(0.26)	(0.99)	(0.50)	(0.88)	(0.63)	(0.88)	(0.51)	(0.84)
CAPITAL EXPENDITURES/SALES	0.021*	0.011***	0.020*	0.011***	0.013	0.011***	0.012	0.011***	0.012	0.011***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.05)	(0.00)	(0.06)	(0.00)	(0.06)	(0.00)
OPERATING IINCOME/SALES	1.219**	0.479**	1.219***	0.466**	0.990***	0.535**	0.942**	0.536**	0.935**	0.530**
	(0.00)	(0.04)	(0.00)	(0.04)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
INTANGIBLE ASSETS/ASSETS	0.607	0.470	0.437	0.799					-0.293	0.761
	(0.34)	(0.36)	(0.48)	(0.15)					(0.62)	(0.17)
EMPLOYEE			-0.000	-0.000					-0.000	-0.000
			(0.95)	(0.40)					(0.32)	(0.12)
GROWTH			0.000	-0.000**					0.000	-0.000**
			(0.21)	(0.04)					(0.26)	(0.03)
INTERNAL OWNERSHIP					-2.803***	-0.879**	-2.749***	-0.945**	-2.604***	-0.951**
					(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
INSTITUTIONAL OWNERSHIP					0.615***	0.672***	0.587***	0.667***	0.608***	0.679***
					(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SALES/ASSETS					0.026	0.069	-0.004	0.089	-0.032	0.075

					(0.84)	(0.47)	(0.98)	(0.36)	(0.82)	(0.45)
MARKET-TO-BOOK							-0.023***	-0.004	-0.025**	-0.003
							(0.01)	(0.15)	(0.02)	(0.17)
OCF/TA							0.390	-0.037	0.448	0.006
							(0.28)	(0.85)	(0.22)	(0.97)
CONSTANT	1.210	0.518	1.191	0.605	4.273***	1.342**	4.736***	1.371**	4.913***	1.607**
	(0.34)	(0.29)	(0.40)	(0.27)	(0.00)	(0.02)	(0.00)	(0.02)	(0.00)	(0.01)
R-squared	0.07	0.05	0.07	0.05	0.23	0.12	0.25	0.13	0.26	0.14
Fixes effects	√	√	√	√	√	√	√	√	√	√
N	531	1365	530	1330	531	1365	530	1330	530	1330

Note: *,**,*** represent significance levels of 10%, 5% and 1% respectively, t statistics are in parentheses.

6.5.3 Analysis of the dynamic panel data model

As mentioned earlier using the OLS model with fixed effects in the context of a dynamic panel approach would lead to bias, as suggested by Nickell (1981), which would mean the lagged dependent variable would be correlated with the time-invariant individual effects. To improve the consistency and efficiency of the estimation, the difference GMM and system model have been introduced into the empirical literature. Threfore, this study has employed a difference GMM model to examine the dynamics of the firm market value with four specifications. The difference GMM model has used a differenced transformation to remove the firm heterogeneity and employs GMM to obtain the estimator. Bond (2002) provided guidance on using dynamic panel models with micro panel data to help determine which method of estimation to use. Before directly focusing on outcomes in detail, it is worth observing the results from the Arellano-Bond tests for AR (2) and the Hansen tests to check whether the autocorrelation and overidentification problems exist in the GMM model respectively. The AR (2) is used for testing the serial correlation assuming the autoregression of the dependent variable with 2 lags and the null hypothesis is of no serial autocorrelation. The results for the four types of GMM model show that there is no higher-order serial correlation of the error term as proved by the Arellano-Bond AR (2) test. The problem of overidentification can be tested by using the Hansen J test, the results of the chi-squared value in Table 6.6 also shows that the instruments are valid as we adjusted the model by curtailing the lag of variables to remove weak instruments, following the methods suggested by Roodman (2009) and Kiviet (2020). These two tests prove the efficiency of the estimates obtained from the difference GMM model.

Table 6.6 summarizes the four specifications estimated by the difference GMM model, while the first specification contains the lagged dependent Tobin's Q, the main explanatory variables and control variables, and the second specification examines the effects of the use of derivatives from the past period on the firm value. As we have found that proxies for information asymmetry and agency problems are significant driving forces of derivatives usage, specification (3) and (4) are constructed by adding derivative ineraction terms with the ratio of intangible assets to total assets and the ratio of sales to total assets repectively. It is followed by Luo and Wang (2018) to include interactive terms into estimation for identifying if the firm value effect of using foreign currency derivatives through the channels of agency problems and asymmetric information.

Concentrating on the relationship of firm value and the use of derivatives, the table presents a significantly positive relationship from the first specification. In the second specification, we find that the derivatives usage from period t-1 do not show significant evidence but the use of derivatives at the current period is positively related to the firm value at 5% significance level. Meanwhile, we observe that derivative usage has a significant value preimium when controlling for the interaction terms with information asymmetry but a negative impact on firm value in specification (4) containing the interative term with the proxy for agency costs. These findings are consistent with the study of Fauver and Naranjo (2010). It suggests that the use of foreign curreny derivatives significantly affects the firm market value although the effects of derivatives usage are mixed. Specification (1), (2) and (3) indicates that there is a positive valuation effect of derivatives usage but the the sign turns to negative when adding the interactive terms with sales to assets, which might suggest that the higher agency costs might undermine the positive valuation effect of derivatives on the firm.

Focusing on the information asymmetry proxy, we observe that the ratio of intangible assets to total assests has a positive effect on the firm value but its interactive term with the derivatives variable has a negative effect on the firm value, which suggests that the asset opaqueness may harm the firm value when the firm chooses to use hedging products. Looking at proxies for agency problems, we notice that the ownership structure has a insignificant effect on the firm value but the coefficient on the ratio of sales to assets exhibits a negative sign and its iteractive term indicates a positive firm value effect through the use of derivatives.

With regards to the results relating to the control variables, it provides a mixed set of results across the specifications but the significant results indicate that the firm's value is negatively related to the firm size and positively related to the profitability. Differnt to the results from the static model, the results of the dynamic model do not show a significant impact from the level of exports.

Table 6.6 Dynamic panel model: Fisrt-step difference GMM

	(1)	(2)	(3)	(4)
L.TOBINQ	0.033	0.022	-0.271	0.008
	(0.22)	(0.88)	(-1.28)	(0.05)
FCD	1.657**	1.520**	6.180*	-10.12**
	(2.01)	(2.20)	(1.92)	(-2.00)
FCDt-1		0.494		
		(0.82)		
EXP	0.019	-0.117	-0.027	-0.066
	(0.03)	(-0.21)	(-0.13)	(-0.46)
SIZE	-0.987**	-1.037**	0.365	-0.228
	(-2.51)	(-2.65)	(0.99)	(-1.03)
QR	-0.194	-0.210	0.008	0.014
	(-1.21)	(-1.38)	(0.32)	(0.55)
LEVERAGE	2.540	2.197	2.308	-1.067
	(1.01)	(0.91)	(1.28)	(-1.30)
DEBT/EBITDA	-0.0001	-0.0034	0.0014	0.0004
	(-0.02)	(-0.08)	(1.51)	(0.51)
CAPITAL EXPENDITURE/SALES	0.043	0.029	0.027	0.019
	(1.29)	(0.81)	(1.60)	(1.67)
OPERATING INCOME/SALES	-1.206	-1.721	2.359*	1.395*
	(-0.69)	(-0.95)	(1.71)	(1.76)
INTERNAL OWNERSHIP	-6.001	-5.857	-2.809	-0.978
	(-1.33)	(-1.28)	(-1.19)	(-0.77)
INSTITUTIONAL OWNERSHIP	-1.250	-1.547	0.977	0.659
	(-0.69)	(-0.85)	(1.51)	(1.31)
SALES/ASSETS	-0.669	0.930	-1.276	-5.332**
	(-0.74)	(-1.00)	(-1.36)	(-2.28)
INTANGIBLE ASSETS/ASSETS	10.94	6.307	86.31*	10.01*
	(0.86)	(0.48)	(1.84)	(1.86)
DER*IATA			-127.4*	
			(-1.91)	
DER*SATA				15.33**
				(1.98)
Hansen	17.61	18.21	2.713	3.537
AR(2)	-0.43	0.77	0.03	1.77
N	1264	1264	1264	1264

*,**,*** represent significance levels of 10%, 5% and 1% respectively, t statistics are in parentheness

6.5.4 Threshold effects analysis

As a previous study by Cheng et al. (2010) has illustrated, there exists a threshold effect arising through the capital structure on the firm's value in China, so this study examines the conditional firm value effect of derivatives usage through the leverage effect. We first take an approximate view of the effect of derivatives for firms with different levels of leverage. Table 6.7 summarizes the results from the estimation of the non-linear effect of the level of debt on the firm value. There is a negative coefficient on the leverage squared term across different specifications, which indicates the non-linear effect (inverted U shape) of the level of debt on the firm, supporting the findings of the study by Black (1976). We separate firms into two groups based on the mean of the leverage as in Table 6.8, which gives estimation results for firms in the lower leverage regime where the leverage is below the mean point and firms in the upper regime where the leverage is above the mean value. Export levels and sales to assets have a positive effect on the firm value in the higher leverage regime. There is a negative size effect on firm value and a positive value effect of increasing the capital expenditures to total sales for the firms within the lower leverage regime.

However, we do not notice any effects from the leverage and the use of derivatives on the firm's maket value. That might be because we approximately chose the mean value as the threshold level of the leverage. As a result, this study intends to employ the static and dynamic threshold model proposed by Wang(2015) and Seo and Shin (2016) with strongly balanced data to identify the effects of the use of foreign derivatives based on the threshold level of the capital structure of the firm, measured by the total debt to total equity. The results, which are summarized in Table 6.9 and Table 6.10, suggest there is a significant threshold level for the leverage on firm value across the specifications. There are four specifications included in Table 6.9. Specification (1) contains the main fim charateristics, including firm size, the quick ratio, the leverage, the ratio of the debt-to-ebitda, the ratio of capital expentidures to sales and the ratio of the operating income to assets. Specification (3) includes proxies for information asymmetry and specification (4) takes agency problems into consideration while specification (2) includes all the factors affecting the firm value. The table 6.10 summarizes the results from employing a dynmic threshold model. Specification (a) regresses the firm value on the main variables and control variables while specification (b) and (c) includes the derivative interactive terms with the information asymmetry and agency proxy variables respectively.

When leverage, as measured by total debt to total equity, is considered as the transition variable, there is a significant threshold level of 0.264 at the 1% significance level across different specifications. In addition, we ran the boostrap tests for non-linearity and the p-value is close to zero, which provides strong evidence for a non-linear effect of leverage on firm value. In the lower regime, the ratio of total debt to total equity exhibits a positive valuation effect but the effect is negative in the upper regime. This evidence supports the threshold effects of leverage on the firm value such that too much debt does not increase firm value. There is an optimal structure to maximize the firm value, as supported by Cheng et al.(2010)

Including lagged observations of the firm value indicate a negative affect on the current firm value when the firm has a higher leverage but a positive effect on the firm value in the lower leverage regime, this may be indicating a more stable affect on firm value when leverage is low. In this case, the current value of firms with a higher risk to the business is negatively affected by its past firm value, as measured by Tobin's Q.

Focusing on the foreign currency derivative usage, we find that coefficients on derivatives are significant and positive in the lower leverage regime but they are not signigicant in the upper regime except for the specification (c) with a negative sign. This is consistent with other studies' results that derivatives have a value-added effect on the firm. Overall this study finds that the use of foreign currency derivatives is positvely related to the firm value, particularly in the firm which has lower leverage ratio. Firms with lower debt levels tend to prefer more risky investments than highly leveraged firms. It is essential in these firms to use hedging strategies to mitigate the risk, which helps to smooth the volatility of cash flows and reduce the probability of financial distress. A high leverage ratio suggests that the firms which have a higher debt level, are more likely to choose less risky investments so that they could payoff debt to the bank. As a result, the use of derivatives is vital for the firms with lower leverage and it can help firms maximize the firm value.

The institutional ownership is negatively related to the firm value in the upper leverage regimes where firms have a relatively lower proportion of equity. In the lower regime, it is observed that the diversified ownership, measured by the share proportion of institutions, has a significantly positive firm value effect, consistent with the study of Fauver and Naranjo (2010), while the internal ownership does not show any significant effects. Additionally, the

ratio of sales to total assets is negatively related to the firm value and its interactive term with derivatives negatively affects the firm value at the 1% significance level while the results of the threshold estimation do not show any effect from the information asymmetry variable. Thus, we can conclude that the agency problems could be a channel for derivatives usage to affect the firm value.

Finally, we pay attention to the effects of firm charateristics in the different regimes. It can be seen that the level of exports positively affects the value of the firm with a higher leverage across the specifications. There is a positive relationship between the size and firm value in the upper leverage regime and the firm value decreases with a higer ratio of operating income to sales. Howerver, in the lower regime, firm size is negatively correlated with Tobin's Q for the firms with lower leverage, which is consistent with the study by Allayannis and Weston (2001) . The quick ratio, a proxy for liquidity, is negatively related with the firm value. Tobin's Q is increasing with the rise in profitability, as estimated by the ratio of operating income to total sales. Also, more growth opportunities lead to higher firm value for the firms with a lower leverage.

Table 6.7 Non-linear effects of leverage: static and dynamic models

	(1)	(2)	(3)	(4)
L.TOBINQ				0.127***
				(0.00)
FCD	-0.000	-0.002	0.000	0.100
	(0.98)	(0.94)	(0.99)	(0.11)
EXP	0.047*	0.048*	0.051*	0.055
	(0.04)	(0.03)	(0.03)	(0.34)
SIZE	-0.0118	-0.0615**	-0.0627**	-0.344***
	(0.72)	(0.05)	(0.04)	(0.00)
INTANGIBLE ASSETS/ASSETS	-0.244		-0.428	-1.655**
	(0.493)		(0.22)	(0.02)
QR	-0.006	-0.005	-0.005	-0.011**
	(0.16)	(0.10)	(0.10)	(0.02)
LEVERAGE	0.520**	0.539**	0.541**	1.038***
	(0.024)	(0.012)	(0.012)	(0.01)
LEVERAGESQ	-0.495	-0.543**	-0.528**	-0.695**
	(0.06)	(0.02)	(0.03)	(0.05)
DEBT/EBITDA	0.000	0.000*	0.000*	-0.000
	(0.06)	(0.02)	(0.02)	(0.77)
CAPITALEXPENDITURE/SALES	0.013***	0.012***	0.012***	0.010**
	(0.00)	(0.00)	(0.00)	(0.03)
OPERATINGINCOME/SALES	0.607***	0.612***	0.602***	0.291
	(0.00)	(0.01)	(0.00)	(0.36)
INTERNAL OWNERSHIP		-1.025***	-1.042***	-2.225***
		(0.00)	(0.00)	(0.00)
INSTITUTIONAL OWENERSHIP		0.599***	0.600***	0.657***
		(0.00)	(0.00)	(0.00)
SALES/ASSETS		0.023	0.016	-0.516**
		(0.77)	(0.83)	(0.02)
CONSTANT	0.903	1.752***	1.803***	
	(0.07)	(0.00)	(0.00)	
Fixed effects	√	√	√	√
N	1896	1896	1896	1264

Note: *,**,*** represent significance levels of 10%, 5% and 1% respectively, t statistics are in parentheses. LEVERAGESQ represents the square of the leverage of the firm. The specification (1), (2) and (3) employ the ordinary least square method to estimate the non-linear effect to the leverage on the firm value and the specification employs GMM to control the dynamic effects of the firm value and estimates the non-linear effects of the leverage.

Table 6.8 FDGMM: Leverage

	LEVERAGE	
	Low	High
L.TOBINQ	-0.00830	0.385
	(-0.05)	(1.51)
FCD	0.649	-0.556
	(0.99)	(-0.66)
EXP	0.332	1.774***
	(0.62)	(3.07)
SIZE	-1.735***	-0.305
	(-3.82)	(-0.62)
QR	-0.169	-0.400
	(-1.35)	(-0.96)
LEVERAGE	4.546	1.082
	(1.90)	(1.02)
DEBT/EBITDA	0.00282	0.00110
	(0.76)	(0.26)
CAPITAL EXPENDITURE/SALES	0.0681**	0.0667
	(2.05)	(1.49)
OPERATING INCOME/SALES	3.701	0.514
	(1.48)	(0.32)
INTERNAL OWNERSHIP	-13.19*	-2.980
	(-1.87)	(-0.98)
INSTITUTIONAL OWNERSHIP	2.554	2.561
	(1.50)	(1.13)
SALES/ASSETS	-1.081	1.777**
	(-0.79)	(2.00)
INTANGIBLE ASSETS/ASSETS	17.77	-0.241
	(1.38)	(-0.02)
Hansen	15.36	15.62
AR(2)	-0.20	0.42
N	702	562

*,**,*** represent significance levels of 10%, 5% and 1% respectively, t statistics are in parentheness

Table 6.9 Threshold model: Static

	(1)	(2)	(3)	(4)
FCD	0.028	0.027	0.090***	0.026
	(0.34)	(0.35)	(0.01)	(0.36)
EXP	0.034	0.036	0.037	0.034
	(0.10)	(0.08)	(0.07)	(0.09)
SIZE	-0.238***	-0.250***	-0.234***	-0.249***
	(0.00)	(0.00)	(0.00)	(0.00)
INTERNAL OWNERSHIP		-0.241		-0.236
		(0.14)		(0.15)
INSTITUTIONAL OWNERSHIP		0.467***		0.463***
		(0.00)		(0.00)
SALES/ASSETS		-0.016		-0.010
		(0.78)		(0.86)
INTANGIBLE ASSETS/ASSETS		-0.253	-0.065	
		(0.38)	(0.82)	
QR	-0.001	-0.001	-0.001	-0.001
	(0.71)	(0.68)	(0.75)	(0.70)
LEVERAGE	-0.004	0.016	0.084	0.013
	(0.96)	(0.84)	(0.32)	(0.87)
DEBT/EBITDA	-0.000	0.000	-0.000	0.000
	(0.88)	(0.98)	(0.77)	(0.97)
CAITALEXPENDITURE/SALES	0.009***	0.010***	0.010***	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)
OPERATING INCOME/SALES	0.502***	0.485***	0.492***	0.490***
	(0.00)	(0.00)	(0.00)	(0.00)
CONTSTANT	4.154***	4.274***	4.076***	4.246***
	(0.00)	(0.00)	(0.00)	(0.00)
Threshold (95%)	0.58	0.58	0.58	0.58
N	1580	1580	1580	1580

Note: *,**,*** represent significance levels of 10%, 5% and 1% respectively, t statistics are in parentheses.

Table 6.10 Threshold model: Dynamic

	(a)		(b)		(c)	
Bootstrap	0.00		0.00		0.00	
Threshold	0.264***		0.264***		0.264***	
	(9.96)		(9.38)		(11.64)	
	Lower	Upper	Lower	Upper	Lower	Upper
L.TOBINQ	0.464***	-0.371***	0.467***	-0.342***	0.477***	-0.528***
	(9.53)	(-3.44)	(10.06)	(-3.37)	(9.92)	(-5.14)
FCD	0.210**	-0.216	0.338***	-0.259	0.616***	-0.652**
	(2.36)	(-1.11)	(2.88)	(-1.14)	(3.65)	(-2.07)
EXP	-0.0731	0.495***	-0.0867*	0.569***	-0.0293	0.355***
	(-1.37)	(4.05)	(-1.66)	(4.87)	(-0.54)	(2.94)
SIZE	-0.534***	0.553***	-0.490***	0.463***	-0.491***	0.458***
	(-8.48)	(5.95)	(-7.81)	(5.03)	(-8.07)	(4.66)
QR	-0.014***	0.030	-0.017***	0.022	-0.014***	0.030
	(-4.04)	(1.76)	(-4.32)	(1.21)	(-4.12)	(1.44)
LEVERAGE	4.344***	-4.025***	4.520***	-4.210***	4.276***	-3.639***
	(5.43)	(-4.15)	(5.79)	(-4.43)	(5.43)	(-3.81)
DEBT/EBITDA	-0.000	0.000	-0.000	0.000	0.000	0.000
	(-0.03)	(1.13)	(-0.57)	(1.64)	(0.78)	(0.41)
CAPITALEXPENDITURE/SALES	0.023***	-0.009	0.020***	-0.006	0.023***	-0.014
	(4.12)	(-1.09)	(3.79)	(-0.72)	(4.01)	(-1.72)
OPERATING INCOME/SALES	2.153***	-3.375***	1.962***	-2.886***	2.063***	-3.328***
	(5.74)	(-6.81)	(5.51)	(-6.32)	(5.49)	(-6.42)
INTERNAL OWNERSHIP	-0.241	-2.354**	-0.050	-2.320***	0.255	-3.714***
	(-0.48)	(-3.04)	(-0.11)	(-3.38)	(0.48)	(-4.45)
INSTITUTIONALOWNERSHIP	0.741***	-1.497***	0.644***	-1.355***	0.778***	-1.381***
	(3.48)	(-4.35)	(3.29)	(-4.35)	(3.59)	(-3.76)
SALES/ASSETS	-1.666***	2.319***	-1.534***	2.034***	-1.294***	1.878***
	(-6.67)	(7.25)	(-6.56)	(7.05)	(-5.80)	(5.36)
INTANGIBLE ASSETS/ASSETS	0.230	-0.094	1.578	-1.696	-1.415	0.703
	(0.25)	(-0.07)	(1.40)	(-0.89)	(-1.82)	(0.62)
CONSTANT	-7.084***		-5.477***		-5.274***	
	(-4.87)		(-3.91)		(-3.38)	
DER*IATA			-2.390	2.089		
			(-1.50)	(0.86)		
DER*SATA					-0.678***	0.765*
					(-2.79)	(1.85)

*,**,*** represent significance levels of 10%, 5% and 1% respectively, t statistics are in parentheness.

6.6 Conclusion

In this chapter, I have examined the effects of the use of curreny derivatives on the firm value and explored the dyamics of firm performance considering the agency problems and information asymmetry. Furthermore, I explore a threshold level effect from the capital structure on the firm and identify the derivative effects in different regimes. In the empirical analysis, the sample comprises data from 316 listed firms in the manufacturing industry on the Shenzhen stock market between 2012 to 2017. Tobin's Q is employed as the measure of the firm's value. We estimate the effect of derivative usage by applying generalized methods of moments with panel data to control for the existence of heterogeneity and incorpcorate instruments to avoid the overidentification problems. In the regression, we additionally control for the firms characteristics, such as size, export levels, liquidity, leverage, profitability and growth opportunities. Currency derivative usage does not show any effect in the static model but it exihbits a significantly positive valuation effect with the estimation of the dynamic model of firm value except when controlling for the agency costs. Higher agency costs have a negative effect through derivative usage on the firm value.

Moerover, the results document that lagged derivative usage does not show any evidence on the firm value. Seo and Shin (2016)'s model is used for the threshold analysis of the firm value and it indicates that there is a significant threshold effect from the leverage effect on firm value, which implies a non-linear relationship between the leverage effect and the firm value. Conditional on the leverage effect, it is observed there are significant dynamic effects from firm value and we find currency derivative usage is positively correlated with the value of the firm with a lower level of leverage.

Diversified ownership structures, implying a higher proportion of institutional shareholdings, could increase the firm value in the lower regime. Overall, we find that not only is the current use of derivatives crucial to the firm but also the the use of derivatives from past periods also significantly affects firm value, suggesting firms that use derivatives, tend to continue using them thereafter. Especially for the firms with lower debt levels, derivatives could be one of the advantageous tools to increase firm value. These results suggest that it is important to consider the leverage effect on the firm value when assessing the impact of derivative use besides controlling for the agency problems and information asymmetry.

Chapter 7

Conclusion

7.1 Summary of results

This study has focused on analysing the use of foreign currency derivatives by firms in the emerging market of China. As the foreign exchange rate regime has been constantly reformed, firms are exposed to more voloatile exchange rates in the market. One of the mainly findings is shown that the level of foreign trade is not only significantly to the foreign exchange exposure but also a significant driver of the use of foreign currency derivatives. Firms involved in more foreign business would face higher foreign exchange exposure than domestic firms. Meanwhile, the level of foreign trade motivate firms to hedge with foreign currency derivatives to reduce loss caused by unexpected exchange rate changes. Moreover, the use of derivatives has a positive effect on the value of firms with lower level of debt and diversified ownership structure is beneficial to the firm value. The benefits of using foreign currency deirvatives on firm value are conditional on the firm's capital structure.

This chapter summarizes the results from empirical tests and makes conclusion related to research questions in the first part. The second part writes about policy implications regarding this study and a brief recommendation for the future research.

Chapter 4 The estimation and determinants of the foreign exchange exposure of Chinese firms

Research question: What is the relationship between stock prices and exchange rates in China? How does the level of foreign trade influence the sensitivity of stock prices to exchange rate changes?

The chapter 4 estimates the foreign exchange exposure to firms in China and explores whether it is caused by the level of foreign involvement. To answer this research question, following Jorion (1990), I first estimate the foreign exchange exposure of all A-share firms listed in the SSE since the exchange rate regime was initiallyreformed in July 2005, which aims to understand whether volatile exchange rates have had a significant affect on firms after the relaxation of regulations on the Chinese exchange rate. I examine the sensitivity of firms' stock price to the change in the Renminbi's value as previous literature focused on US study but also

explore the lagged effect from the exchange rate. It is found that around 7% of the sample have a significant contemporaneous foreign exchange exposure, which is similar to what previous studies found in the US market. Meanwhile, 6% of firms experience a lagged effect from exchange rate changes, which indicates a lagged impact before firms respond to the change of the value of the Renminbi. Therefore, similar to the US studies, few firms exhibit significant negative foreign exchange exposure, which indicates that the firms stock prices would drop with the appreciation ot the domestic currency. The firms value is opposite to the change of the exchange rate because it is found that there is a negative exposure to firms as the Renminbi appreciates. The results are consistent with the study of Gu, Wang Ma (2016) who only concentrated on a specific industry. Furthermore, I investigate the relationship between the foreign involvement and the exchange exposure. The foreign involvement is significantly related to the foreign exchange exposure after 2012 rather than the whole sample period, which is an interesting result. It might be accounting for the relaxation of short-selling making the financial market more liberalised, which can better reflect the shock to the listed firms. This is the first study accounting for the liberalisation of the stock market in China since 2012.

Chapter 5 The determinants of foreign currency derivative usage in China

Research question: What are main determinants of foreign currency derivative usage for hedging?

From the previous chapter I found that few companies experience significant exchange rate exposure, which might imply that firms would take strategies to reduce risks caused by exchange rates. Chapter 5 determines what factors could motivate firms to use foreign exchange derivatives for hedging. Due to the accouting disclosure of derivatives data required from 2012, I collected derivative data from firms' annual reports and footnotes from 2012 to 2017. In the manufacturing sector, there is around 40% of the 316 multinational firms that are hedgers who use foreign currency derivatives. As the level of foreign trade is positively correlated with the foreign exchange exposure, the foreign trade will motivate the firm to use foreign currency derivatives to smooth the expected earnings. This chapter has examined the determinants of the use of foreign currency derivatives with static and dynamic probit models. The results from the static model show that firms engaged with higher levels of foreign trade are more likely to use currency derivatives. Also, the probability of using foreign currency derivatives rises with the growing size and the growth opportunities, which is consistent with

the findings from Allayannis and Weston (2001), Fauver and Naranjo (2010) and Lel (2012). Additionally, as in Fauver and Naranjo (2010), I consider the asymmetric information and agency problems in the estimation and find that those problems are significantly related to the use of foreign currency derivatives, which is more likely when there is more information asymmetry. Firms with lower agency costs are more likely to use the foreign currency derivatives for hedging, which is contrary to other literature on the US. As derivative markets in the US are more developed and flexible than those in China, firms are more likely to use currency derivatives for speculation when there is higher agency costs, as suggested by Fauver and Naranjo (2010). The Chinese markets are heavily regulated in terms of speculation which could explain why the firms with higher agency costs exhibit less probability of hedging with derivatives. Both a higher ratio of intangible assets to total assets and the ratio of sales to assets leads to higher probability of the use of currency derivatives. I discover that the ownership structure is insignificantly related to the derivatives usage.

Moreover, I investigate the dynamic relationship of the use of currency derivatives with the standard and Heckman estimation which gives lower coefficients on the lagged variable as it solves the endogeneity problems in the regression. It is found that the current decision on using currency derivatives depends on the use of derivatives in the previous period. In the dynamic model, the level of trade and the firm size still exhibit significant relationships with the use of foreign currency derivatives. With exchange rates added to the model for a robustness check, similar results are obtained as in the previous estimation.

Chapter 6 The dynamic effects of the use of currency derivatives on the firm value: A threshold analysis based on capital structure

Research question: How is the shareholder's value affected by hedging with currency derivatives over time? What is the effect of hedging with currency derivatives on firm value conditional on a threshold of capital structure?

Chapter 6 concentrates on exploring the valuation effect of hedging with foreign currency derivatives by employing static, dynamic and threshold models. I further examine the effect of the use of currency derivatives on the firm, aiming to fin out whether derivatives use would increase firm value through asymmetric information and agency channels. In the static model, the use of currency derivatives is insignificantly related to firm value as measured by Tobin's

Q. It is observed that the use of derivatives is siginfictantly affect the firm value but the one time period lagged usage does not affect the firm value in the difference GMM. To investigate in depth, I examine the threshold effect of the use of currency derivatives conditional on the leverage with the model developed by Seo and Shin (2016), which allows endogenous variables in the non-linear regression. The models also allow that firms could move between hedgers and non-hedgers across sample period. Agency problems and information asymmetry are considered as the channel for the firm value effect of the use of foreign currency derivatives for the first time on Chinese market. The results show there is a significant non-linear relationship between the leverage and the firm value. In the lower leverage regime, the use of derivatives is positively related to the firm value. The firm value is increasing with the leverage in the lower regime. It is also found that the diversified ownership structure leads to higher firm value. Also, a higher ratio of sales to assets is causing a lower firm value. In contrast, there is no obvious value effect from using currency derivatives in the upper leverage regime. Overall, this chapter gives an interesting result which could contribute to the research in this area. The use of currency derivatives is beneficial to firm value with respect to the firm's capital structure. The firms with lower levels of debt are more likely to increase the firm value by using currency derivatives.

7.2 Policy implications

As China is experiencing an era of transformation from a planned economy to a market economy, the financial market is constantly being liberalised and exchange rates also are more flexible than before. It is essential to understand the use of foreign currency derivatives by firms, which are important to investors, creditors and regulators in the financial market.

There are several main points, which are as follows,

- The exchange rate regime should be continuously promoted to be more flexible, such as extending the floating band, and the financial markets should be liberalised at the same time to ensure the markets are efficient.

- It is essential to educate market participants, such as shareholders, creditors and regulators, on awareness of foreign exchange risks in an open economy and making the appropriate risk management strategies.

- Firms should cautiously use foreign currency derivatives by considering their capital structure as there would be an optimal level of capital under the current exchange rate regime.

In this study, firstly, I found that foreign involvement is positively related to the foreign exchange exposure post 2012 rather than the previous period. It indicates that the capital market can well reflect the shock from exchange rates in a more flexible and liberalised market. Meanwhile, firms with higher levels of foreign involvement should be careful with managing the changes of the currency as the increasing scale of foreign trade could lead to a large exposure to exchange rate risks.

Secondly, this study assesses the determinants of the use of foreign currency derivatives. The manufacturing firms with higher levels of foreign trade are more likely to use derivatives. Also, the increasing firms' size would motivate firms to take currency derivatives to lock in exchange risks. The foreign currency derivatives are beneficial to firms to manage foreign transactions in case the exchange rate changes would cause unexpected losses from trade in the future. Similarly, large firms use derivatives to smooth the volatility of expected earnings to attract creditors. Additionally, the decision on the use derivatives is positively related to the current strategies. On the one hand, the forward contracts usually take more than one year. On the other hand, firms with derivatives tend to a have professional knowledge of financial derivatives, which would motivate them to use derivatives to make profits in the following years. Derivatives in China are not as well developed as western countries and the executives lack professional knowledge and experience using them. It is essential to popularize the knowledge related to the use of currency derivatives, which would promote the development of derivatives markets further and the control of currency risks across firms.

Thirdly, as MM theory illustrated, there is no valuation effect from derivative usage in the perfect environment, but this study is focusing on examining the effect of the use of currency derivatives on firm value considering agency costs and information asymmetry. It is found that there is no significant relationship between agency costs and derivative usage but firms with asymmetric information have a higher probability of hedging with foreign currency derivatives. It might be because firms benefit from information advantages when hedging with derivatives.

However, as use of derivatives is a double-edged sword, it should excite the regulator's attention to ensure information and disclosure are transparent to ensure financial market stability.

Different to previous studies, this study finds a positive valuation effect from the use of foreign currency derivatives conditional on the capital structure. There is a significant non-linear relationship between the leverage and the firm value. In the lower level of the leverage regime, the use of currency derivatives increases firm value and the diversified structure is positively related to firm value. This supports the hedging theory of Smith and Stulz (1985), the use of derivatives has a positive valuation effect through lowering the agency costs in the real world. In the upper regime, there is no significant relationship between firm value and the use of derivatives. Thus, the firm with higher levels of debt would not benefit from using currency derivatives as the firm might experience other risks such as a heavy debt burden. The firms with lower leverage not only benefit from a tax-shield from the debt but also benefit from using foreign currency derivatives by lowering exchange rate exposure in turn increasing the firm value. The use of foreign currency derivatives could be an indicator of firm value and stable earnings for investors and creditors.

Overall, the study of the use of currency derivatives can encourage various stakeholders to think into their use in the future. As the Chinese economy is developing rapidly and firms are engaged in more foreign transactions, the use of financial currency derivatives is becoming more popular in the market. For firms, the use of derivatives should be considered carefully. The executives should be trained in the advanced knowledge of derivatives and be familiar with the products and regulations in the financial markets. Based on findings from Chapter 6, it is essential for firms to consider the level of debt when making decisions on whether to use foreign currency derivatives to hedge. Firms with a large size can use foreign currency derivatives to reduce the exchange rate shocks to achieve a stable cash flow in terms of earnings while small firms can use operational hedging activities to eliminate their exposure to foreign business. Meanwhile, corporate governance plays an important role in operating the business, which enable executives to use derivatives to hedge rather than for speculation which might be harmful to the financial markets. It is important to guide managers to concentrate on the long-term goal of sustainable developments instead of focusing on the short-term profits. In China managers are not allowed to bet on the market with the use of derivatives.

For creditors and investors, the behaviour of firms using financial derivative might be an indicator of the firm's performance. The firms with foreign currency derivatives could increase firm value, especially for the firms with lower leverage, which would affect the investors' decision in the capital market. The use of foreign currency derivatives could be considered as a signal for creditors to issue loans because the use of derivatives is positively related to the growth opportunities of firms and firms would experience less volatility of earnings than firms without derivatives to hedge risks. Thus, firms using foreign currency derivatives are more likely to be able to afford repayments in the future.

Derivatives have been popularized in the markets as the use of derivatives can help firms respond to exchange rate shocks and increase the market value. Financial institutions should consider diversifying financial derivatives products and make them accessible for more firms to use, such as American options and digital options. It is essential to expand the derivatives market for the further progress of China's trade and the liquidity and efficiency of foreign exchange market should be further developed though relaxing control on exchange rates to promote the capital flows. However, the authorities and regulators need to be cautious in developing financial derivatives which also could destabilize the market as was the case in the US financial crisis, if the derivatives markets are not well regulated. The exchange rate regime should be continuously reformed to make the exchange rate more flexibleto reflect the external shocks to the economy and it should quickly react to the market demand and supply. The restrictions on foreign exchange markets and derivative markets should be continuously relaxed to make more flexible markets for investors or multinational firms. Regulators should complete the regulatory framework to secure financial market stablity. Transparent disclosures of derivatives are required to avoid speculation in the market. Regualators can create mechanisms to monitor risks dynamically and set up warning systems to detect the risks as early as possible. It is essential to educate market participants to use derivatives with causious ness and make them aware of foreign competion and forigen exchange risks in an open economy. Overall, it is crucial for enhancing financial stability for the authorities and regulators to develop an appropriate regulatory structure when expanding the derivatives market and allowing more flexibility of exchange rates.

The study points to important findings about estimating the foreign exchange exposure of firms from all industries in China and exploring the relationship between hedging and the firm value within the manufacturing sector. This study mainly contributes to the literature with an

extension to an emerging market where the exchange rates are floating within a limited range and through finding the positive firm valuation effects of the use of foreign currency derivatives conditional on a threshold level of the debt. There are several limitations to this study. This study focuses on the traditional approach to estimating the foreign exchange exposure by employing a two-factor model, which is proposed by Jorion (1990). The model can be extended to a multi-factor model, which takes macroeconomic factors and other firm charateristics into account. I employ the binary variable to proxy for the use of foreign currency derivatives as the accounting disclosure was incomplete for the first several years when the firms were required to disclose derivative usage. In exploring the determinants and firm valuation effect of the use of foreign currency derivatives, the study employs multinational firms in the manufacturing sector, which could be extended to other sectors.

Future studies can extend the research into more sectors by increasing the size of the sample as data becomes complete and convenient to collect. Models with more up to date quantitative data can produce results which provide more comprehensive information. As the accounting standards for the disclosure of derivatives has been developed constantly, it could become possible to measure the use of derivatives with a continuous variables instead of the dummy variable with more complete derivatives data in the firms' annual reports. Responding to foreign exchange exposure, this study considers the foreign currency derivatives only but it would be meaningful to examine other types of financial derivatives or a combination of derivatives, such as interest rate derivatives and commodities derivatives. The studies in the future can employ more proxies for agency conflicts and asymmetric information, such as research and devlopement costs. In addition to agency costs and information asymmetry, it is also worthwile considering coporate governance, such as board composition and characteristics of management teams, into the study as the use of risk management strategies as managers and shareholders have different goals for the firm's development. Compared with shareholders, managers have a short-term perspective when they choose risky investments without considering the risk controls for the long-term performance. Effective coporate governance can mitigate the conflicts of interest between shareholders and managers, in turn affecting the decision to use hedging strategies. With the development of the derivatives market in the future, further studies can employ event studies to investigate the factors affecting hedging with derivatives and the efficiency of using derivatives to mitigate risks for firms.

Appendix

Table A.1 Estimation of model (4.10)

Estimation for the foreign exchange exposure (β_{1i})			
	2005.07-2017.12	2005.07-2011.12	2012.01-2017.12
Min	-3.336	-4.483	-3.867
Median	-0.382	-0.46	-0.302
Max	2.376	2.351	3.306
Cross-sectional mean	-0.340	-0.410	-0.339
Cross-sectional SD	0.950	1.120	1.555
the No. of significant	10	1	6
the percentage of significant firms out of the total firms	7.87%	0.7%	4.72%
No. of positive	42	41	56
No. of negative	85	86	71
Stability, No. of firms with same sign for exposure		70	

Table A.2 An extension to estimate for the foreign exchange exposure (Fama-French Three-Factor Model)

	Coefficients	t-statistics
ER	-4.893	-1.46
RMT	5.761***	16.08
SMB	-0.330***	-15.80
HML	-0.116	-1.58
CONSTANT	4.507***	15.18
R-squared	14.76%	
N	1685	

Note: *,**,*** represent significance levels of 10%, 5% and 1% respectively. The results are obtained by regressing the model $R_{it} - r_{ft} = \delta_0 + \delta_1 ER_t + \delta_2(R_{mt} - r_{ft}) + \delta_3(SMB_t) + \delta_4(HML_t) + \upsilon_t$. R_{it} represents the rate of stock return of the firm while r_{ft} indicates the risk free rate represented by the rate of 10-year treasury bond. ER is measured by the Chinese real effective exchange rates and R_{mt} is represented by the market return of Shanghai composite market index. SMB represents small minus big, measured by market capitalization of firms while HML indicates high mius low, measured by the ratio of book-to-market. All the data have been collected from Winddata base, from 2005 to 2017. There are 127 firms listed from Shanghai Stock Exchange.

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